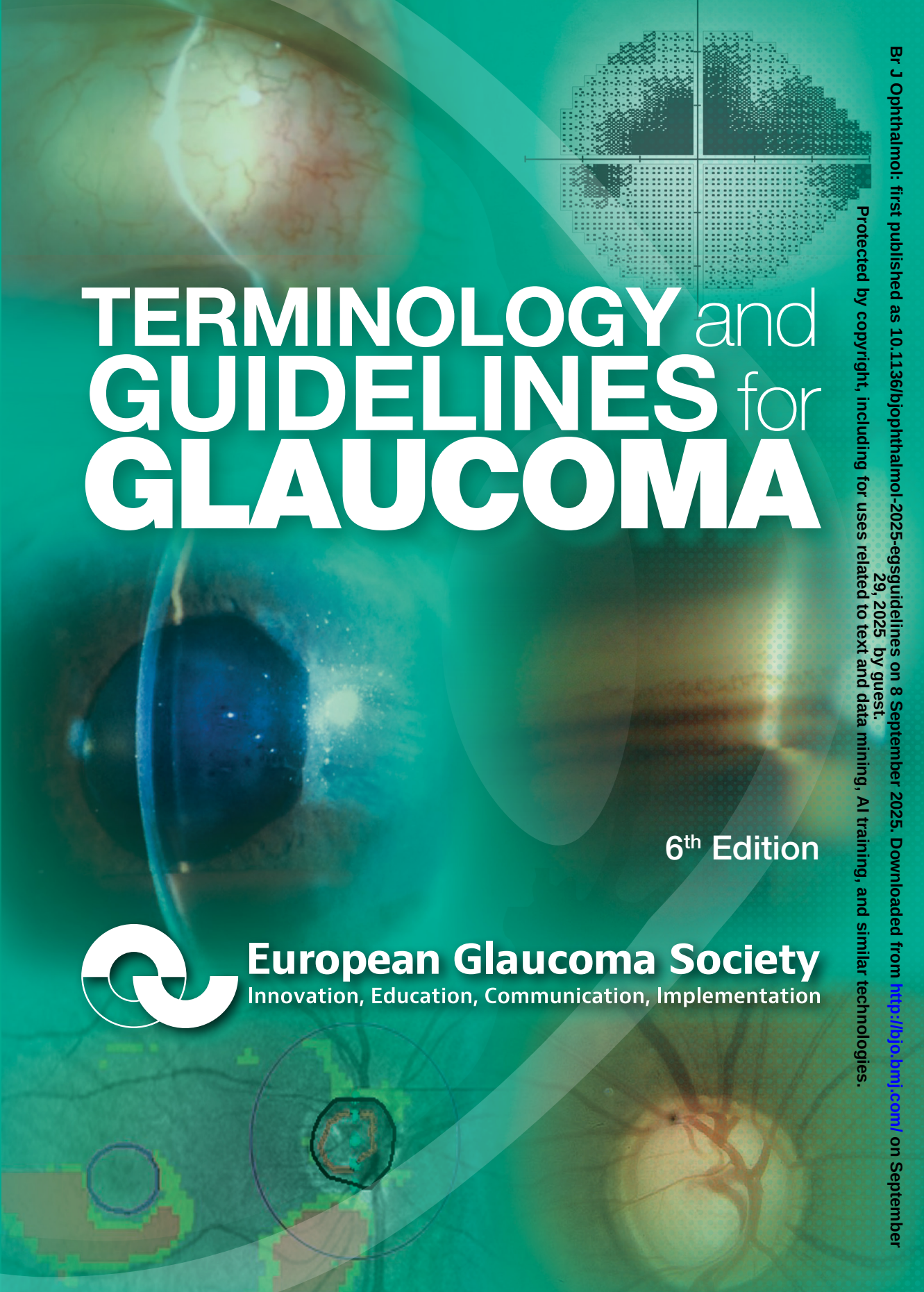


TERMINOLOGY and GUIDELINES for GLAUCOMA

6th Edition

European Glaucoma Society

Innovation, Education, Communication, Implementation

Br J Ophthalmol: first published as 10.1136/bjophthalmol-2025-egsguidelines on 8 September 2025. Downloaded from http://bjo.bmj.com/ on September 29, 2025 by guest.
Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

Br J Ophthalmol: first published as 10.1136/bjophthalmol-2025-egsguidelines on 8 September 2025. Downloaded from http://bjo.bmj.com/ on September 29, 2025 by guest.
Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

ISBN 979-12-80718-29-7

PLATFORM
NETWORK

Via Paleocapa 17/7
17100 Savona - Italy

Stamperia Artistica Nazionale SpA
Printed in EU
May 2025

Copyright © 2025 European Glaucoma Society

No parts of this text, illustrations, tables or flowcharts can be reproduced, copied, translated or stored by any means including magnetic, electronic or multimedia formats without written permission of the European Glaucoma Society.

TERMINOLOGY and GUIDELINES for GLAUCOMA

6th Edition

European Glaucoma Society

Innovation, Education, Communication, Implementation

Br J Ophthalmol: first published as 10.1136/bjophthalmol-2025-egsguidelines on 8 September 2025. Downloaded from http://bjo.bmj.com/ on September 29, 2025 by guest.
Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

Br J Ophthalmol: first published as 10.1136/bjophthalmol-2025-egsguidelines on 8 September 2025. Downloaded from http://bjo.bmj.com/ on September 29, 2025 by guest.
Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

Contents

page

Foreword 10
Introduction 11
Glossary 14

Part I 17
I.1 Background to Guideline Development 19
I.2 Mission statement 20
I.3 Key questions and evidence-based recommendations 20
I.3.1 New questions for this edition 20
I.3.2 Feedback from patients on Edition V questions 25
I.4 Choosing wisely / Things to avoid 32
I.5. What matters to patients 34
I.5.1 Anxiety associated with glaucoma 34
I.5.2 The information gap 34
I.5.3 Tips for doctors 36
I.5.4 Key points for healthcare providers working with paediatric glaucoma patients 36
I.6 Glaucoma epidemiology 39
I.6.1 Burden of glaucoma 39
I.6.2 Natural history of glaucoma and blindness 39
I.6.3 Risk factors for glaucoma 40
I.6.4 The future of glaucoma management and policy implications 40
I.7 Landmark randomised controlled trials for glaucoma 44
I.7.1 Treatment vs no treatment trials in open angle glaucoma 44
I.7.2 Treatment vs no treatment trials on angle closure 50
I.7.3 Studies comparing treatment in open angle glaucoma 52
I.7.4 Studies comparing treatment in angle closure 63
I.8 Cost-effectiveness of glaucoma care and glaucoma screening 65
I.8.1 Cost-effectiveness of glaucoma care 65
I.8.2 Screening for glaucoma 65
I.8.3 Clinical and cost-effectiveness of diagnostic tests used for screening, detection and monitoring for glaucoma 65
I.8.4 Cost-effectiveness of treatment of glaucoma and ocular hypertension preventing visual disability 65
I.8.5 Cost-effectiveness research and glaucoma 66
I.9 Terminology, classification and definitions 67

Part II
Chapter 1 Patient Examination
II.1.1 Intraocular Pressure (IOP) and Tonometry 74
II.1.1.1 Methods of measurement (tonometry) 75

Br J Ophthalmol: first published as 10.1136/bjophthalmol-2025-egsguidelines on 8 September 2025. Downloaded from http://bjo.bmj.com/ on September 29, 2025 by guest. Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

Contents

	page
II.1.1.2 Intraocular pressure and corneal thickness	80
II.1.2 Gonioscopy	**81**
II.1.2.1 Anatomy	82
II.1.2.2 Techniques	85
II.1.2.3 Grading of the anterior chamber angle	89
II.1.2.4 Anterior segment imaging techniques	91
II.1.3 Optic nerve head and retinal nerve fibre layer	**93**
II.1.31 Clinical examination	93
II.1.3.2 Recording of the ONH and RNFL features	99
II.1.4 Perimetry	**103**
II.1.4.1 Perimetry techniques	103
II.1.4.2 Interpreting test results	104
II.1.5 Artificial intelligence	**110**
II.1.5.1 Key challenges	110
II.1.5.2 Solutions and future directions	110
II.1.6 Genetics	**112**
II.1.6.1 Mendelian mutations	112
II.1.6.2 Complex variants	113
II.1.6.3 Third party genotyping	113

Chapter 2 Classification and Terminology

II.2.1 Childhood glaucoma	**117**
II.2.1.1 Classification	117
II.2.1.2 Primary Congenital Glaucoma (PCG)	118
II.2.1.3 Juvenile Open Angle Glaucoma (JOAG)	121
II.2.1.4 Secondary Childhood Glaucoma	121
II.2.2 Open angle glaucoma	**124**
II.2.2.1 Primary open angle glaucoma (POAG)	124
II.2.3 Secondary open angle glaucoma	**129**
II.2.3.1 Secondary open angle glaucoma caused by ocular disease	129
II.2.3.2 Secondary open angle glaucoma due to ocular trauma	134
II.2.3.3 Iatrogenic secondary open angle glaucoma	135
II.2.3.4 Secondary open angle glaucoma caused by extraocular disease	137
II.2.4 Angle closure	**138**
II.2.4.1 Primary angle closure glaucoma	139
II.2.5 Secondary angle closure	**151**
II.2.5.1 Secondary angle closure with pupillary block	151
II.2.5.2 Secondary angle closure with anterior “pulling” mechanism synechial	151

Br J Ophthalmol: first published as 10.1136/bjophthalmol-2025-egsguidelines on 8 September 2025. Downloaded from http://bjo.bmj.com/ on September 29, 2025 by guest. Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

Contents

page

Chapter 3 Treatment

II.3.1 General principles **159**
II.3.2 Treatment options **162**
II.3.3 Target IOP **163**
II.3.3.1 Setting the target IOP 163
II.3.3.2 Achieving and re-evaluating the target IOP 166
II.3.4 General principles of medical management **167**
II.3.4.1 Start with monotherapy 167
II.3.4.2 Switch to another monotherapy 168
II.3.4.3 Add second drug / combination therapy 169
II.3.5 IOP-lowering drops **172**
II.3.5.1 Prostaglandin analogues (PGAs) 179
II.3.5.2 Local toxicity of topical treatment: the role of preservatives 179
II.3.5.3 Generic IOP-lowering topical medications 180
II.3.6 Dietary supplementation, alternative therapies **180**
II.3.7 Lifestyle factors **180**
II.3.8 Glaucoma management during pregnancy or breast-feeding **181**
II.3.9 Neuroprotection and glaucoma treatment **184**
II.3.10 Practical considerations related to topical medical treatment **184**
II.3.11 Adherence in glaucoma **185**
II.3.11.1 Terminology 185
II.3.11.2 Factors associated with non-adherence 186
II.3.11.3 Identifying non-adherence 186
II.3.11.4 Improving adherence 186
II.3.12 Laser surgery **187**
II.3.12.1 Laser Peripheral Iridotomy (LPI) 187
II.3.12.2 Laser Trabeculoplasty 188
II.3.12.3 Thermal laser peripheral iridoplasty (TLPI) 190
II.3.13 Cyclo-ablative procedures **192**
II.3.14 Incisional surgery **193**
II.3.14.1 General principles 193
II.3.14.2 Techniques 194
II.3.14.3 Methods of preventing filtering bleb scarring 202
II.3.14.4 Alternative methods of preventing filtering bleb scarring 205
II.3.15 Cataract and glaucoma surgery **206**

Br J Ophthalmol: first published as 10.1136/bjophthalmol-2025-egsguidelines on 8 September 2025. Downloaded from http://bjo.bmj.com/ on September 29, 2025 by guest.
Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

Flowcharts

		Page
FC I	Suggested questions for your glaucoma patient	33
FC II	Mechanism of IOP increase	68
FC III	First examination	74
FC IV	Gonioscopy technique	82
FC V	Diagnostic gonioscopy in open angle glaucoma	83
FC VI	Interpretation initial visual field test	107
FC VII	Diagnostic strategy when initial visual field is abnormal	108
FC VIII	Treatment options	125
FC IX	Assessment and follow-up intervals	126
FC X	Initial management of angle-closure	140
FC XI	Management of primary angle closure	141
FC XII	Management of chronic angle closure	142
FC XIII	Management of acute primary angle closure attack	148
FC XIV	Target IOP decision-making factors	163
FC XV	Target IOP considerations	166
FC XVI	Target IOP adjustment	167
FC XVII	Considerations on first choice medical treatment	168
FC XVIII	Medical management – Choosing therapy	169
FC XIX	Treatment algorithm in glaucoma topical therapy	185

Br J Ophthalmol: first published as 10.1136/bjophthalmol-2025-egsguidelines on 8 September 2025. Downloaded from http://bjo.bmj.com/ on September 29, 2025 by guest.
Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

Figures

		Page
Figure I.6.2	Evaluation of functional loss/time for individualised treatment	38
Figure I.7.1	Landmark randomised controlled trials for glaucoma and year of first published results	44
Figure II.1.1	Technique of Goldmann Applanation Tonometry	76
Figure II.1.2	Correct alignment of the fluorescein ring	77
Figure II.1.3	The “corneal wedge”	81
Figure II.1.4	Direct and indirect gonioscopy	85
Figure II.1.5	The double hump sign	87
Figure II.1.6	Dynamic indentation gonioscopy	88
Figure II.1.7	The Spaeth Grading System of gonioscopy finding	90
Figure II.1.8	The Van Herick test	92
Figure II.1.9	The ISNT rule	94
Figure II.1.10	Worsening of glaucomatous damage at the optic disc	95
Figure II.1.11	Optic disc haemorrhage	96
Figure II.1.12	ONH with parapapillary atrophy	97
Figure II.1.13	Direct clinical examination of the optic nerve head using a high power	98
FC XVII	Considerations on first choice medical treatment convex lens at the slit lamp	168
Figure II.1.14	Optic nerve heads with different disc areas	99
Figure II.3.1	The whom-to-treat graph	161
Figure II.3.2	Diagrammatic evaluation of Target IOP	165
Figure II.3.3	The pre - post IOP graph	170
Figure II.3.4	IOP lowering molecules and year of first clinical use	171

Br J Ophthalmol: first published as 10.1136/bjophthalmol-2025-egsguidelines on 8 September 2025. Downloaded from http://bjo.bmj.com/ on September 29, 2025 by guest.
Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

Foreword

We practice medicine in times of exponentially increasing medical knowledge. In 1950, it was estimated that the doubling time was 50 years; by 1980, it was 7 years and by 2010, 3.5 years. In 2020, it was projected to be just 73 days! To continue to practice evidence-based medicine and to provide the best possible care for our patients, clinicians need to adapt their strategies to keep their knowledge up to date. There will always be a role for critical appraisal of individual studies in the field of a clinician's practice, but with such an increase in the volume of published research, it becomes impossible to appraise all relevant material. For this reason, sources of distilled knowledge, such as the EGS Guidelines, become essential references for best practice medicine. Rigorous methods for evidence synthesis, such as the systematic reviews overseen by Cochrane, provide a comprehensive summary of the current state of knowledge for important clinical questions. However, for many clinical uncertainties, there is little or no high-quality evidence, let alone an evidence synthesis. Where evidence is lacking, practice guidance needs to be built from expert opinion and consensus, while acknowledging the limitations of such an approach. Expert opinion, derived from sound medical knowledge and years of practice experience, also has an important role in understanding the relevance of lines of evidence and the nuances of implementing them in practice. Thus, the expert commentary around the evidence base given in these Guidelines is essential for proper implementation of published evidence. Importantly, the EGS Guidelines also include 'Choosing wisely' elements indicating actions which should be avoided due to insufficient evidence and/or unsubstantiated belief. Guidelines need regular updating to take account of new knowledge and aspects of clinical care that have not been given sufficient emphasis in the past. This 6th Edition of the EGS Guidelines includes an updated 'evidence based' section with new clinical questions and evidence-based answers. The section 'What matters to patients' has also been updated, recognising that, because Guidelines are typically written by clinicians for clinicians, there have been gaps in understanding the patient perspective. The updated section now has direct input from the Expert by Experience patient advisors in the EGS Patient Involvement Project and includes eight Tips for Doctors in their communication with patients. The Guidelines team, led by Drs Pazos, Traverso and Viswanathan, is to be congratulated for the 6th Edition of the Guidelines, updating and enhancing the previous edition, while maintaining the highly success format which gives a framework for glaucoma care, based on evidence synthesis and consensus expert opinion, and presented as a 'How to' manual for patient diagnosis and management.

David (Ted) Garway-Heath
Glaucoma UK Professor of Ophthalmology, UCL

Br J Ophthalmol: first published as 10.1136/bjophthalmol-2025-egsguidelines on 8 September 2025. Downloaded from http://bjo.bmj.com/ on September 29, 2025 by guest.
Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

Introduction

The European Glaucoma Society Guidelines are at the heart of our educational mission serving not only our members, but all involved in glaucoma care. Previous editions have been among the most widely accessed documents in the field, helping navigate the growing complexity of glaucoma research and clinical practice.

This sixth edition reaffirms our commitment to evidence-based, patient-centred care. It builds on the solid foundations of past editions while embracing key innovations that reflect new scientific insights, emerging technologies, and evolving priorities in glaucoma care.

For the first time, we collaborated closely with patient representatives through the Experts by Experience (EbE) group. Their contributions helped shape clinical questions and emphasized the importance of empathy, communication, and psychological support in managing glaucoma.

The Guidelines maintain a dual purpose: to answer clinically relevant questions through a rigorous evidence-based approach, and to offer comprehensive, practical knowledge for daily use. We have updated existing recommendations and added new topics, including artificial intelligence, cost-effectiveness, adherence strategies, and paediatric glaucoma. A new "Choosing Wisely" section provides clear guidance to avoid low-value interventions.

We extend our heartfelt thanks to all contributors and collaborators. This includes the many colleagues who authored and reviewed chapters with great care and expertise, the patient representatives who generously shared their lived experiences, and the team at the University of Genoa, who worked tirelessly to refine content and layout, ensuring clarity and consistency throughout.

A very special word of thanks goes to the Editors Marta Pazos, Carlo Traverso, and Ananth Viswanathan, whose relentless dedication, critical oversight, and countless hours of work were instrumental in shaping the high quality and coherence of this edition. Their leadership and perseverance have been extraordinary.

Together, these collective efforts have made this edition a cornerstone of our vision: to foster innovation, strengthen education, enhance communication, and promote best practices in glaucoma care across Europe and beyond.

Ingeborg Stalmans and Luis Abegao Pinto

Br J Ophthalmol: first published as 10.1136/bjophthalmol-2025-egsguidelines on 8 September 2025. Downloaded from http://bjo.bmj.com/ on September 29, 2025 by guest.
Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

Br J Ophthalmol: first published as 10.1136/bjophthalmol-2025-egsguidelines on 8 September 2025. Downloaded from http://bjo.bmj.com/ on September 29, 2025 by guest.
Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

Editors
Marta Pazos
Carlo E. Traverso
Ananth Viswanathan

Evidence-Based Working Group
Methodological oversight
Augusto Azuara-Blanco
Manuele Michelessi

Leaders of evidence review
Augusto Azuara-Blanco
Manuele Michelessi (*EGS*)
Marta Pazos (*EGS*)
Riaz Qureshi
(*US Cochrane Eyes and Vision Group*)

Evidence review
Augusto Azuara-Blanco
João Barbosa Breda
Carlo Alberto Cutolo
Gerhard Garhöfer
Manuele Michelessi
Marta Pazos
Verena Prokosh
Andrew Tatham

Evidence consensus panel
Luís Abegão Pinto
Augusto Azuara-Blanco
Gauti Jóhannesson
Marta Pazos
Norbert Pfeiffer
Ingeborg Stalmans
Andrew Tatham Carlo E. Traverso Ananth Viswanathan

Evidence patient's feedback panel Stelios Georgoulas
Marta Pazos Andrew Tatham

The Guidelines Task Force
Luís Abegão Pinto
Eleftherios Anastasopoulos
Florent Aptel
Augusto Azuara-Blanco (*advisor*)
João Barbosa Breda
Luca Bagnasco
Chiara Bonzano
Rupert Bourne
Carlo Alberto Cutolo
Theodoros Filippopoulos
Panayiota Founti
Gerhard Garhöfer
Gus Gazzard
Dimitrios Giannoulis
Michele Iester
Andreas Katsanos
Anthony Khawaja
Miriam Kolko
Antoine Labbé
Sophie Lemmens
Manuele Michelessi
Ana Miguel
Francesco Oddone
Marta Pazos (*chair*)
Verena Prokosch
Alessandro Rabiolo
Alexander K Schuster
Cédric Schweitzer
Riccardo Scotto
Andrew Tatham
Marc Toeteberg-Harms
Fotis Topouzis
Carlo E. Traverso (*chair*)
Ananth Viswanathan (*chair*)

The Guidelines Writers, Authors and Contributors
Luís Abegão Pinto
Ike Ahmed
Zeynep Aktas
Augusto Azuara-Blanco
Alessandro Bagnis
João Barbosa Breda
Chiara Bonzano
Rupert Bourne
Paola Cassotana
Maria Francesca Cordeiro
Carlo Alberto Cutolo
Barbara Cvenkel
Panayiota Founti
Julian García-Feijoo
Gerhard Garhöfer
Ted Garway-Heath
Daniele Gaudenzi
Gus Gazzard
Stelios Georgoulas
Francisco Goñi
Franz Grehn
Anders Heijl
Esther Hoffman
Michele Iester
Gauti Jóhannesson
Anthony Khawaja
Anthony King
Miriam Kolko
Evgenia Konstantakopoulou
Yves Lachkar
Sanna Leinonen
Sophie Lemmens
Karl Mercieca
Manuele Michelessi
Francesco Oddone
Marta Pazos
Dorothea Peters
Norbert Pfeiffer
Verena Prokosch
Luca Rossetti
John Salmon
Leopold Schmetterer
Cédric Schweitzer
Riccardo Scotto
Ingeborg Stalmans
Gordana Sunaric-Mégevand
Ian Tapply
Andrew Tatham
John Thygessen
Fotis Topouzis
Carlo E. Traverso
Neeru Vallabh
Ananth Viswanathan

The Guidelines Internal Reviewers
Luís Abegão Pinto
Elefterios Anastasopoulos
Florent Aptel
João Barbosa Breda
Henny Beckers
Chiara Bonzano
Rupert Bourne (*ccordinator*)
Alain Bron
Carlo A. Cutolo
Barbara Cvenkel
Theodoros Filippopoulos
Panayiota Founti
Gerhard Garhöfer
Dimitrios Giannoulis
Franz Grehn
Ingrida Januleviciene
Stylianos Kandarakis
Andreas Katsanos
Anthony Khawaja
Anthony King
James Kirwan
Miriam Kolko
Antoine Labbé
Sanna Leinonen
Sophie Lemmens
Keith Martin
Jose Maria Martinez de la Casa
Frances Meier-Gibbons
Stefano Miglior
Ana Miguel
Giovanni Montesano
Marta Pazos
Sergei Petrov
Verena Prokosch
Alessandro Rabiolo
Cédric Schweitzer
Alexander K Schuster
Ingeborg Stalmans
Marc Toeteberg-Harms
Fotis Topouzis
Carlo E. Traverso
Anja Tuulonen
Ananth Viswanathan
Zoya Veselovskaya
Ilgaz Yalvaç
Mia Zoric Geber

The Experts by Experience Group (patients' panel)
Kate Backhaus
Carol Bronze
Asle Haaukas
Mona Krieg
Deborah Loi
Dora Rolo
Sarah Tayler

Team of Clinica Oculistica - University of Genova, Policlinico Ospedale San martino IRCCS - for medical editing and graphics
Luca Bagnasco
Alessandro Bagnis
Chiara Bonzano
Paola Cassottana (*EGS Fellow*)
Carlo Catti
Carlo Alberto Cutolo
Daniele Gaudenzi (*EGS Fellow*)
Michele Iester
Maria Musolino
Riccardo Scotto
Carlo E. Traverso

External Reviews from Glaucoma Societies
AGS
APGS
WGA
LAGS
PAGS

The EGS Executive Committee
Ingeborg Stalmans (*President*)
Luís Abegão Pinto (*Vice President*)
Norbert Pfeiffer (*Treasurer*)
Fotis Topouzis (*Past President*)
Gauti Jóhannesson (*Secretary*)
Marta Pazos (*Adjunct Secretary*)
Panayiota Founti
Sanna Leinonen
Luca Rosetti

The Board of The EGS Foundation
Carlo E. Traverso
Fotis Topuzis
John Thygesen
Franz Grehn
Anders Heijl

All contributors have provided the appropriate COI visible in detail at www.eugs.org/pages/guidesurgical/

Br J Ophthalmol: first published as 10.1136/bjophthalmol-2025-egsguidelines on 8 September 2025. Downloaded from http://bjo.bmj.com/ on September 29, 2025 by guest.
Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

Glossary

5-FU	5-fluorouracil
AAC	Acute angle closure
ACG	Angle closure glaucoma
AGIS	Advanced glaucoma intervention study
AH	Aqueous humour
AI	Artificial intelligence
ALT	Argon laser trabeculoplasty
ANA-LIS	Singapore asymptomatic narrow angles laser iridotomy study
AS-OCT	Anterior Segment OCT
BAC	Benzalkalonium chloride
CCT	Central corneal thickness
CDR	Cup to disc ratio
CGRN	Childhood glaucoma research network
CIGTS	Collaborative initial glaucoma treatment study
CNTGS	Collaborative normal tension glaucoma study
DCT	Dynamic contour tonometry
EAGLE	Effectiveness of early lens extraction for the treatment of primary angle closure glaucoma
EbE	Expert by experience
EGPS	European glaucoma prevention study
EGS	European glaucoma society
EMA	The European Medicines Agency
EMGT	Early manifest glaucoma trial
FC	Fixed combination
Fc	Flow chart
FDT	Frequency doubling technology
FL	Fixation losses
FN	False negatives
FP	False positive
GAT	Goldmann applanation tonometry
GC	Ganglion cell
GDD	Glaucoma long tube draining device
GHT	Glaucoma hemifield test
GITS	Glaucoma intensive treatment study
GRADE	Grading of recommendations, assessment, development and evaluations
HRT	Heidelberg retina tomography
ICE	Irido-corneal endothelial syndrome
IOL	Intraocular lens
IOP	Intraocular pressure
IPL	Iridoplasty
ITC	Iridotrabecular contact
IV	Intravenous
LiGHT	Laser in glaucoma and ocular hypertension trial
LoGTS	Low-tension glaucoma treatment study
LPI	Laser peripheral iridotomy
LV	Loss variance
MD	Mean defect or mean deviation

Br J Ophthalmol: first published as 10.1136/bjophthalmol-2025-egsguidelines on 8 September 2025. Downloaded from http://bjo.bmj.com/ on September 29, 2025 by guest.
Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

Glossary

MIBS	Minimally Invasive Bleb-forming Shunts
MIGS	Minimally invasive glaucoma surgery
MMC	Mitomycin C
NCT	Non-contact tonometry
Nd:YAG	Neodymium-doped yttrium aluminum garnet
NTG	Normal tension glaucoma
OAG	Open angle glaucoma
OCT	Optical coherence tomography
OHT	Ocular hypertension
OHTS	The ocular hypertension treatment study
ONH	Optic nerve head
ORA	Ocular response analyser
OSD	Ocular surface disease PAC Primary angle closure
PACG	Primary angle closure glaucoma
PACS	Primary angle closure suspect
PAS	Peripheral anterior synechiae
PCG	Primary congenital glaucoma
PDS	Pigment dispersion syndrome
PGA	Prostaglandin analogue
POAG	Primary open angle glaucoma
PG	Pigmentary glaucoma
PRS	Polygenic risk score
PSD	Pattern standard deviation
PTVT	Primary tube versus trabeculectomy study
PXF	Pseudoexfoliation syndrome
PXFG	Pseudoexfoliation glaucoma
RCT	Randomised controlled trial
RNFL	Retinal nerve fiber layer
RoP	Rate of progression
SAP	Standard automated perimetry
SITA	Swedish interactive threshold algorithm
SLT	Selective laser trabeculoplasty
SWAP	Short-wavelength automated perimetry
TAGS	Treatment of advanced glaucoma study
TLPI	Thermal laser peripheral iridoplasty
TM	Trabecular meshwork
TVT	Tube versus trabeculectomy study
UBM	Ultrasound biomicroscopy
UGH	Uveitis-glaucoma-hyphaema syndrome
UKGTS	United Kingdom glaucoma treatment study
VEGF	Vascular endothelial growth factor
VF	Visual field
VFI	Visual field index
ZAP	Zhongshan angle closure prevention trial

Br J Ophthalmol: first published as 10.1136/bjophthalmol-2025-egsguidelines on 8 September 2025. Downloaded from http://bjo.bmj.com/ on September 29, 2025 by guest.
Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

Br J Ophthalmol: first published as 10.1136/bjophthalmol-2025-egsguidelines on 8 September 2025. Downloaded from http://bjo.bmj.com/ on September 29, 2025 by guest.
Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

Br J Ophthalmol: first published as 10.1136/bjophthalmol-2025-egsguidelines on 8 September 2025. Downloaded from http://bjo.bmj.com/ on September 29, 2025 by guest.
Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

Part I

Br J Ophthalmol: first published as 10.1136/bjophthalmol-2025-egsguidelines on 8 September 2025. Downloaded from http://bjo.bmj.com/ on September 29, 2025 by guest.
Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

The Guidelines project was entirely supported by the European Glaucoma Society Foundation

Part I

I.1 Background to Guideline Development

These Guidelines aim to support ophthalmologists in managing people with, or at risk of, glaucoma, and to provide useful information to trainees. In the previous 5th edition, we identified and answered 11 clinically relevant questions. To update this section for this 6th edition, we also followed again the grading of recommendations, assessment, development, and evaluations (GRADE) methodology (https://gdt.gradepro.org/app/ handbook/handbook.html). We asked the EGS members and the EGS Experts by Experience (EbE-EGS patients' committee) group to identify key clinical questions on glaucoma care. Specifically we sent an online Survey to all EGS members in September 2024 and to EbE-EGS in October 2024, asking them to confirm if questions from the 5th edition were still important and to provide feedback on the previous questions and also to propose new key question topics, for example, diagnosis, prognosis, and interventions for primary open-angle glaucoma. The Guidelines Task Force subsequently identified the most common topics and prioritised them. Evidence to inform these Guidelines was gathered in 2024 in collaboration with the USA-Cochrane Eyes and Vision Group by conducting an overview of systematic reviews on glaucoma interventions, prognosis, and diagnosis. Similar to the last edition, a grading system for rating the quality of evidence and strength of recommendation, following the grading of recommendations, assessment, development, and evaluations (GRADE), has been used only to answer our final key questions. The remainder of the recommendations and suggestions throughout the text are consensus-based among experts.

As in the previous edition, we provided only references to high-quality systematic reviews, landmark glaucoma trials, and population-based studies with a preference for European-based studies.

Patients' care and well-being are at the core of our values, and we collaborated side by side with the EGS EbE group to include the patient's perspective throughout the Guidelines, e.g., identifying key clinical questions, including a do's and don'ts section for doctors as well as a new chapter about the paediatric glaucoma patients' most frequent concerns. Material used to develop the Guidelines is available online.

The European Glaucoma Society (EGS) Guidelines should be considered as guidance rather than strict decision-making protocols.

Decision-making ultimately should be individualised to the patient's needs and circumstances, ideally guided by the best available evidence.

The European Glaucoma Society (EGS) and all contributors disclaim responsibility and all liability for any adverse medical or legal effects resulting directly or indirectly from the use of any of the definitions, diagnostic techniques, treatments or protocols described in the Guidelines. The EGS does not endorse any product, procedure, company or organisation.

The Guidelines project was entirely supported by the European Glaucoma Society Foundation

Br J Ophthalmol: first published as 10.1136/bjophthalmol-2025-egsguidelines on 8 September 2025. Downloaded from http://bjo.bmj.com/ on September 29, 2025 by guest. Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

I.2 Mission statement

"The goal of care for people with or at risk of glaucoma is to promote their well-being and quality of life (QoL) within a sustainable healthcare system."
Well-being and QoL are influenced by a person's visual function, the psychological impact of having a chronic progressive sight-threatening condition and the costs as well as side-effects of treatments. Costs include inconveniences to the individual and their caregivers as well as the financial cost of examinations, diagnostic procedures and therapies, both to the individual and society. The effect of visual function on well-being and QoL is variable; in general, early to moderate glaucoma has only a modest influence, whereas advanced visual function loss in both eyes may considerably reduce QoL.

I.3 Key questions and evidence-based recommendations

I.3.1 New questions for this edition

Q1. What risk factors should we consider when we assess a person with or at risk of glaucoma?
Recommendation:
Risk of disease:
Patients with higher IOP (particularly those with pseudoexfoliation), non-white ethnicity (particularly black), older age, family history of glaucoma, myopes are at higher risk for the development of glaucoma. Other risk factors may include: blood pressure dysregulation, cardiovascular disease. In OHT, older age and higher IOP were consistently associated with glaucoma conversion.
Disease progression:
Higher IOP, pseudoexfoliation, older age, presence of disc hemorrhages, and thinner CCT.
Level of evidence: high
Strength of recommendation: strong
Comment:
There is some evidence that some patients over-treated for systemic hypertension may be at increased risk of glaucoma and VF loss. Data from the literature on diabetes, systemic high blood pressure, migraine, Raynaud syndrome, Alzheimer´s disease and H. pylori infections are inconsistent. There is no compelling evidence that diet and lifestyle factors influence glaucoma (see Ch II.3.7).

The Guidelines project was entirely supported by the European Glaucoma Society Foundation

Br J Ophthalmol: first published as 10.1136/bjophthalmol-2025-egsguidelines on 8 September 2025. Downloaded from http://bjo.bmj.com/ on September 29, 2025 by guest.
Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

Q2. What is the recommended first-line treatment for POAG?

Recommendation:

It is recommended to initiate the treatment for IOP lowering with monotherapy (see Ch II.3.4, Fc XVII, XVIII and XIX). Laser trabeculoplasty is also a good option for first-line treatment (see Ch II.3.12.2). Patients with high IOPs, e.g., high 20s or above or severe disease may need a more intensive initial treatment e.g. combination of drugs, laser or surgery.

Level of evidence: high

Strength of recommendation: strong

Comment

One high quality trial showed that SLT is at least as effective as eye drops. Laser trabeculoplasty should be considered as an option for initial treatment in patients with mild or moderate open angle glaucoma or OHT. There is no evidence regarding effectiveness of trabeculoplasty in patients with severe glaucoma and pigmentary glaucoma (PG). SLT and argon laser trabeculoplasty (ALT) have similar efficacy and are more effective in people with higher IOP.

Factors such as co-morbidities, systemic therapy, adherence, ability to administer drops, patient preference, cost, and availability should be considered.

Q3. What is the most effective IOP-lowering medication?

Recommendation: Prostaglandin analogs (PGAs) are the most effective medication, and they are usually recommended as first-choice medical treatment for open-angle glaucoma.

Level of evidence: high

Strength of recommendation: strong

Comment:

There is no difference in IOP lowering between preservative and preservative-free treatments. Preservative-free medications are probably associated with better ocular surface and tolerability, but they are more costly. Further research comparing original and generic PGAs is needed to confirm equivalence.

Factors like possible adverse effects, co-morbidities, systemic therapy, adherence, patient preferences, life expectancy, cost, and availability should be considered in selecting a drug for a given patient. Patients need to be informed about the options that are available and what is best suited for them.

The Guidelines project was entirely supported by the European Glaucoma Society Foundation

Br J Ophthalmol: first published as 10.1136/bjophthalmol-2025-egsguidelines on 8 September 2025. Downloaded from http://bjo.bmj.com/ on September 29, 2025 by guest. Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

Q4. How can clinicians help patients adhere to the medical treatment?
Recommendation:
Simplified regimen, education, effective communication (e.g., asking open questions), alarms/messages.
Level of evidence: very low
Strength of recommendation: strong
Comment:
Tailored care may improve adherence to glaucoma medication. A multidisciplinary approach may yield additional improvements.

Q5. What is the recommended surgical treatment for non-advanced open- angle glaucoma?
Recommendation:
Trabeculectomy remains the most effective glaucoma surgery in terms of IOP lowering. Stand-alone MIGS techniques mainly aim to reduce the IOP and/or the medication burden in patients with early to moderate open-angle glaucoma. Bleb- forming techniques have the potential for greater IOP reduction when compared to MIGS.
Level of evidence: High for trabeculectomy; Low for stand-alone MIGS and alternative bleb-forming surgeries.
Strength of recommendation: Strong
Comment:
Glaucoma surgery should be considered whenever medical or laser treatment is unlikely to maintain sight in the glaucomatous eye.

Q6. What is the recommended surgical treatment for advanced open-angle glaucoma?
Recommendation:
In advanced open glaucoma, trabeculectomy is the most effective glaucoma surgery to obtain low target IOPs. Trabeculectomy can be offered as a primary intervention.
Level of evidence: high
Strength of recommendation: strong
Comment:
Trabeculectomy has obtained better IOP and VF outcomes when compared to medical therapy. MIGS are not usually indicated for patients with advanced glaucoma. Other bleb-forming surgeries can be used for advanced glaucoma.

The Guidelines project was entirely supported by the European Glaucoma Society Foundation

Br J Ophthalmol: first published as 10.1136/bjophthalmol-2025-egsguidelines on 8 September 2025. Downloaded from http://bjo.bmj.com/ on September 29, 2025 by guest.
Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

Q7. What is the recommended approach for patients with early or moderate open-angle glaucoma and visually significant cataracts?

Recommendations:

– IOP at or near target: Phacoemulsification alone or phacoemulsification with MIGS.
– IOP significantly above target: Glaucoma intervention should be offered. Bleb-forming surgery with or without phacoemulsification is advisable.

Level of evidence: high

Strength of recommendation: strong

Comment:

Cataract surgery alone is not recommended for controlling glaucoma, although it can modestly but consistently reduce IOP and medications in POAG, with a more pronounced effect in eyes with PXG and higher preoperative IOP values. When making a treatment recommendation, clinicians should consider the benefits of early MIGS surgery in the context of the patient characteristics (medical and non-medical, lifestyle, expectations, etc). Combined procedures using MIGS can moderately lower IOP and reduce medication use. For more severe glaucoma or cases with high preoperative IOP, a bleb-forming surgery such as trabeculectomy is preferred.

Since the success rate for bleb-forming procedures is higher when performed alone than when combined with cataract surgery, performing cataract surgery first is advisable if the clinical condition allows.

Q8. What is the recommended approach for patients with advanced open-angle glaucoma and visually significant cataracts?

Recommendations:

– IOP at target: Phacoemulsification alone is a good option; phacoemulsification may be combined with MIGS as an opportunity to lower IOP more or to reduce drop burden.
– IOP above target: Glaucoma intervention should be offered. Bleb-forming surgery with or without phacoemulsification is advisable.

Level of evidence: low

Strength of recommendation: strong

Comment:

For more severe glaucoma or cases with high preoperative IOP, a bleb-forming surgery like trabeculectomy is preferred. Since the success rate for bleb-forming procedures is higher when performed alone than when combined with cataract surgery, performing cataract surgery first may be advisable if the clinical condition allows.

The Guidelines project was entirely supported by the European Glaucoma Society Foundation

Br J Ophthalmol: first published as 10.1136/bjophthalmol-2025-egsguidelines on 8 September 2025. Downloaded from http://bjo.bmj.com/ on September 29, 2025 by guest. Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

Q9. Are neuroprotective agents or alternative treatments recommended?

Recommendation:

There is no evidence to support that acupuncture, cannabinoids, or alternative treatments have a role to play in glaucoma management. There is not enough evidence to recommend the use of neuroprotective agents in glaucoma.

Level of evidence: low

Strength of recommendation: strong

Comment:

Oral supplementation of citicoline and nicotinamide are currently being tested in large clinical trials as potential neuroprotective adjuvants for glaucoma management.

Q10. What is the recommended frequency of testing and monitoring?

Recommendation:

There is no evidence regarding which combination of tests or testing frequency improves patient outcomes at a sustainable cost. See recommended tests for diagnosis and monitoring in flow chart IX. Follow-up intervals of less than 1 year for ocular hypertension are unlikely to be cost-effective. Increasing the frequency may be needed based on various factors such as glaucoma severity, faster progression rate, non-achievement of target IOP, presence of other high-risk factors, the need for a second test to establish baseline values for future comparisons, or suspicion of artifacts.

Level of evidence: low

Strength of recommendation: strong

Comment:

Most publications and test progression software are based on the assumption that at least five tests i.e. two baseline and three follow-up tests are needed to detect probable progression, and a minimum of two years is necessary to obtain a representative numerical progression rate. Other studies have found that performing two to three tests per year may be sufficient to detect fast-progressors in clinical practice.

The Guidelines project was entirely supported by the European Glaucoma Society Foundation

Br J Ophthalmol: first published as 10.1136/bjophthalmol-2025-egsguidelines on 8 September 2025. Downloaded from http://bjo.bmj.com/ on September 29, 2025 by guest.
Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

Q11. Is AI recommended for glaucoma management?
Recommendation:
Although they have promising potential, there is insufficient evidence to support the use of AI algorithms in current clinical practice.
Level of evidence: low
Strength of recommendation: strong
Comment:
Challenges in generalisability, data privacy and ownership, explainability and interpretability must be addressed before widespread clinical adoption. AI has the potential to aid glaucoma diagnosis and detection of progression and may allow screening to be more cost-effective. Additionally, AI tools may be useful for patient risk profiling and predicting future developments. Clinical trials are ongoing to better evaluate its real-world utility and future clinical implementation.

I.3.2 Feedback from patients on Edition V questions

Q.V.1. What are the recommended tests at first assessment?
The following tests are recommended at first assessment:
Visual acuity and refractive error.
Strength of recommendation: strong
Slit lamp examination
Strength of recommendation: strong
Gonioscopy
Strength of recommendation: strong
Tonometry
Strength of recommendation: strong
Central corneal thickness (CCT)
Strength of recommendation: weak
Visual field (VF) testing
Strength of recommendation: strong
Clinical assessment of the optic nerve head (ONH), retinal nerve fiber layer (RNFL), and macula.
Strength of recommendation: strong
Optical coherence tomography (OCT) of disc/RNFL/macula can be useful, but the diagnosis of glaucoma cannot be made on the basis of OCT alone.
Strength of recommendation: weak
Level of evidence: The direct evidence addressing this specific question is 'very low' for all recommendations.
The comments and consensus on this question have been updated and are now summarised in a table at the beginning of the diagnostics section II.1.

Patients' perspective: These tests need to be explained to the patient - what they are for and the reason for the sequence of testing

The Guidelines project was entirely supported by the European Glaucoma Society Foundation

Br J Ophthalmol: first published as 10.1136/bjophthalmol-2025-egsguidelines on 8 September 2025. Downloaded from http://bjo.bmj.com/ on September 29, 2025 by guest. Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

Q.V.2. Alternative tonometers other than Goldmann applanation tonometry (GAT): Are they recommended in clinical practice?

Recommendation:
Consensus could not be reached about which alternative tonometers other than GAT can be used in clinical practice.
Level of evidence: very low
Strength of recommendation: weak
The comment and consensus on this question have been updated and are now included in the IOP section (Ch II.1.1).

Patients' perspective: No comments

Q.V.3. Is it recommended to set a target IOP?

Recommendation:
A target IOP should be set as a treatment goal at diagnosis. Target IOP should be updated at each monitoring visit based on changes in glaucoma or other ocular or systemic diseases.
Level of evidence: low
Strength of recommendation: strong
The comment and consensus to this question have been updated and are now included in the General principles of treatment and management section (Chapter II.3.1 page 159).

Patients' perspective: We recommend that it needs to be specified that target pressure is individually based on type of glaucoma, corneal thickness, and other factors

Q.V.4. Central corneal thickness (CCT): is it recommended to use CCT to risk profile patients? (see also Q1 and Q2)

Recommendation:
CCT may be useful for baseline risk profiling.
Level of evidence: low
Strength of recommendation: weak
The comment and consensus to this question have been updated and are now included in the IOP section (Ch II.1.1.1)

Patients' perspective: Need to explain why corneal thickness is measured

The Guidelines project was entirely supported by the European Glaucoma Society Foundation

Br J Ophthalmol: first published as 10.1136/bjophthalmol-2025-egsguidelines on 8 September 2025. Downloaded from http://bjo.bmj.com/ on September 29, 2025 by guest.
Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

Q.V.5. Anterior chamber angle evaluation with imaging tests: are they recommended to diagnose people with angle closure?

Recommendation:

Anterior chamber angle imaging cannot replace gonioscopy. Gonioscopy should be performed in every patient being evaluated for glaucoma or ocular hypertension.

Level of evidence: low

Strength of recommendation: strong

The comment and consensus to this question have been updated and are now included in the gonioscopy section (Ch II.1.2).

Patients' perspective: No comments

Q.V.6. Optical Coherence Tomography (OCT): what is the role of OCT for diagnosis of glaucoma? Answered in Q1.

The comment and consensus on this question have been updated and are now summarised in a table at the beginning of the diagnostics section (Ch II.1.3.2)

Patients' perspective: Patients need a full explanation of the purpose of this measurement and explanation of the abbreviation

Q.V.7. What are the recommended tests for monitoring?

Visual acuity

Strength of recommendation: strong

VF testing

Strength of recommendation: strong

Clinical examination of the optic disc and RNFL

Strength of recommendation: strong

Tonometry

Strength of recommendation: strong

OCT disc/RNFL/macula imaging

Strength of recommendation: weak

Repeated gonioscopy in some circumstances

Strength of recommendation: weak

Level of evidence: The direct evidence addressing this specific question is 'very low' for all recommendations.

The comments and consensus on this question have been updated and are now summarised in a table at the beginning of the diagnostics section II.1.

Patients' perspective: Patients need to be informed of what these tests involve

The Guidelines project was entirely supported by the European Glaucoma Society Foundation

Br J Ophthalmol: first published as 10.1136/bjophthalmol-2025-egsguidelines on 8 September 2025. Downloaded from http://bjo.bmj.com/ on September 29, 2025 by guest. Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

Q.V.8. What is the role of OCT for monitoring glaucoma? Answered in Q7 The comment and consensus related to this question have been updated and are summarised in the diagnostics section (Ch II.1.3).

Patients' perspective: Patients need to be informed of what these tests involve and why

Q.V.9. Alternative models of care: virtual clinics / asynchronous decision making: are they acceptable?

Recommendation:
virtual clinics/asinchronous decision making can be an efficient way of delivering glaucoma care.
Level of evidence: very low
Strength of recommendation: weak

Patients' perspective: We feel there are so many country-specific differences (roles of orthoptists, optometrists and opticians) that it would not be possible to give a one-size-fits-all answer

Q.V.10. Medical treatment: what is the most effective and what is the first- choice medication for open-angle glaucoma?

Recommendation:
Prostaglandin analogs (PGAs) are the most effective medication and they are usually recommended as first-choice treatment for open-angle glaucoma.
Level of evidence: high for IOP reduction but very low for other outcomes.
Strength of recommendation: strong
We have rephrased, and updated this question with new evidence and consensus (new question Q3).

Patients' perspective: Patients need to be informed about the options that are available and what is best suited for the patient

Q.V.11. What interventions can improve adherence to medical treatment?

Recommendation:
simplified regimen, education, effective communication (e.g., ask open questions), alarms/ messages.
Level of evidence: very low
Strength of recommendation: weak
We have kept, rephrased, and updated this question with new evidence and consensus (question Q4).

Patients' perspective: This relates to how the patient feels about a number of issues surrounding their treatment and clinicians might consider how they can help patients adhere

The Guidelines project was entirely supported by the European Glaucoma Society Foundation

Br J Ophthalmol: first published as 10.1136/bjophthalmol-2025-egsguidelines on 8 September 2025. Downloaded from http://bjo.bmj.com/ on September 29, 2025 by guest.
Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

Q.V.12. Is laser trabeculoplasty recommended as initial treatment?
Recommendation:
Laser trabeculoplasty can be offered as a first-choice treatment for open angle glaucoma.
Level of evidence: moderate (only one high-quality trial, LiGHT Ch I.see I.7.3.8.)
Strength of recommendation: strong
See also question Q2.

> *Patients' perspective:* Under what circumstances is laser trabeculoplasty recommended as an initial treatment?

Q.V.13. What is the recommended surgical treatment for open-angle glaucoma?
Recommendation:
Trabeculectomy augmented with antifibrotic agents is recommended as an initial surgical treatment for open angle glaucoma.
Level of evidence: low
Strength of recommendation: strong
We have rephrased, and updated this question with new evidence and consensus (questions Q5, Q6, Q7 and Q8).

> *Patients' perspective:* No comments

The Guidelines project was entirely supported by the European Glaucoma Society Foundation

Br J Ophthalmol: first published as 10.1136/bjophthalmol-2025-egsguidelines on 8 September 2025. Downloaded from http://bjo.bmj.com/ on September 29, 2025 by guest. Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

Q.V.14. What is the recommended intervention for primary angle closure disease?
With the exclusion of eyes with cataract, following an acute attack of angle closure (AAC) or nanophthalmos.
Interventions depend on the spectrum of disease and presence of cataract. Laser and surgical treatment is typically combined with medical treatment.

Primary angle closure suspect (PACS):
Recommendation:
LPI in high risk individuals, e.g., high hyperopia, patients requiring repeated pupil dilatation for retinal disease or with difficult access to healthcare facilities.
Level of evidence: low
Strength of recommendation: "weak"

Primary angle closure (PAC) and primary angle closure glaucoma (PACG), for people under 50 years of age:
Recommendation:
LPI
Level of evidence: low
Strength of recommendation: "strong"

PAC and PACG, for people over 50 years of age:
Recommendation:
lens extraction or LPI
Level of evidence: moderate (one good quality trial, EAGLE)
Strength of recommendation: strong
The comment and consensus to this question have been updated and are now included in the Angle-closure and Landmark Trials sections (Ch I.7.2, I.7.4.1 and Fc X-XI).

Patients' perspective: No comments

The Guidelines project was entirely supported by the European Glaucoma Society Foundation

Br J Ophthalmol: first published as 10.1136/bjophthalmol-2025-egsguidelines on 8 September 2025. Downloaded from http://bjo.bmj.com/ on September 29, 2025 by guest.
Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

Q.V.15. Medical treatment: what is the most effective and the first choice medication for PACG, after interventions for widening the anterior chamber angle have been done?
Recommendation: Prostaglandin analogues are the most effective medication.
Level of evidence: low
Strength of recommendation: strong
The comment and consensus to this question have been updated and are now included in the Angle-closure and Landmark Trials sections (Ch I.7.2.1, I.7.2.2, I.7.4.1, II.2.4 and Fc X).

Patients' perspective: No comments

Q.V.16. What is the recommended glaucoma surgery for PACG, after interventions for widening the anterior chamber angle have been done?
Interventions depend on the lens status and glaucoma severity.

Pseudophakic with PACG:
Recommendation:
filtration surgery (trabeculectomy)
Level of evidence: very low
Strength of recommendation: strong

Phakic with PACG:
Recommendation:
phacoemulsification alone or combined phacoemulsification + glaucoma surgery
Level of evidence: very low
Strength of recommendation: strong
The comment and consensus to this question have been updated and are now included in the Angle-closure and Landmark Trials sections (Ch I.7.2.1, I.7.2.2, I.7.4.1, II.2.4 and Fc X).

Patients' perspective: No comments

The Guidelines project was entirely supported by the European Glaucoma Society Foundation

Br J Ophthalmol: first published as 10.1136/bjophthalmol-2025-egsguidelines on 8 September 2025. Downloaded from http://bjo.bmj.com/ on September 29, 2025 by guest.
Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

I.4 Choosing wisely / Things to avoid

1) **Do not use in clinical practice research results derived from samples which do not adequately represent your patient.**
2) **Do not perform Laser peripheral iridotomy (LPI) routinely in otherwise healthy Primary Angle-Closure Suspect (PACS) eyes.**
   LPI is advisable only in high-risk PACS eyes (e.g. higher baseline IOP, high hypermetropia, antidepressants or benzodiazepines use, patients that need frequent pupil dilation).
3) **Do not perform clear lens extraction in patients below 50 years of age with angle closure at low risk of visual loss.**
   Evidence suggests that clear lens extraction is a valid first line intervention for a specific group of PAC patients, e.g. those with high IOP and above 50 years of age.
4) **Do not use anterior chamber angle imaging as a replacement for gonioscopy.**
   The accuracy of anterior segment imaging in diagnosing angle closure is uncertain. Imaging misses relevant information (e.g. pigmentation) and angle closure features (e.g. peripheral anterior synechia or ciliary processes)
5) **Do not correct IOP measurements with CCT-based algorithms.**
   They are not validated and should be avoided.
6) **Do not focus optic disc assessment on cup/disc ratio.**
   Observe the ONH directly with slit lamp or direct ophthalmoscope checking disc appearance, size, shape and the thickness and colour of the rim. A green filter light can help to observe RNFL around the optic disc.
7) **Do not diagnose glaucoma based on OCT only.**
   OCT on its own does not provide a clinical diagnosis of glaucoma, just a statistical deviation from a reference database.
8) **Do not make clinical decisions based on AI only.**
   Technologies may support but do not replace clinical judgment.
9) **Do not offer genotyping routinely to all POAG patients.**
   Individuals from families with multiple members affected with POAG at a relatively young age should be offered the opportunity to undergo genetic testing for MYOC mutations.
10) **Do not rely on neuroprotective strategies over IOP-lowering therapies.**
    Treatment priority should be reaching the target IOP with established hypotensive therapies.
11) **Do not presume that acute angle closure is always due to pupil block.**
    Pilocarpine may worsen angle closure due to lenticular and retro-lenticular mechanisms.
12) **Do not dismiss axial length measurements in patients with angle closure.**
    Shorter eyes are at particular risk of surgical complications and should be planned accordingly.
13) **Do not perform further interventions in blind painless eyes with high IOP.**
    Once the vision is lost, there is no need to perform further interventions except for painful eyes when pain is due to high IOP.
14) **Do not consider MIGS as a procedure without risks or costs.**
15) **Do not use MIGS on a rapidly worsening patient**
    MIGS are mostly used in to offer the opportunity to mildly lower the IOP and decrease medications in patients with OSD, poor tolerance, or poor compliance.

The Guidelines project was entirely supported by the European Glaucoma Society Foundation

Br J Ophthalmol: first published as 10.1136/bjophthalmol-2025-egsguidelines on 8 September 2025. Downloaded from http://bjo.bmj.com/ on September 29, 2025 by guest.
Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

FC ISuggested questions for your glaucoma patient

At baseline

How are you?

- History/risk factors
- Specifically enquire about
  - All medications
  - Family history (general/ophthalmological)
  - Corticosteroid therapy (topical/systemic)
  - Ocular trauma or inflammation
  - Ocular surgery and concomitant eye diseases
  - Refractive surgery
  - Cardiovascular or respiratory diseases/other chronic or severe diseases
  - Vascular disorders
  - Drugs allergy
  - Lifestyle and occupation
  - Specific situations: consider sickle-cell disease in African-descent patients, pregnancy plans in younger women
- Ask patient to repeat what they have understood and leave time for questions

At follow-up

How are you?

Do you think your condition is better, stable or worse?
How are you managing with your daily tasks?
Is your vision affecting your mobility?
What do you understand about your diagnosis?
How are you managing with your drops?
Have you been using your eye drops as prescribed?
Do you administer the drops yourself or does a relative?
If by yourself, please show me how you do it

- It is also important to emphasize the need for the patients to take some responsibility: making note of their eye pressure and being informed about possible therapies
- Discuss lifestyle: the importance of physical activity, nutrition, avoiding stress, smoking, etc.
- Ask patient to repeat what they have understood and leave time for questions

© European Glaucoma Society

The Guidelines project was entirely supported by the European Glaucoma Society Foundation

Br J Ophthalmol: first published as 10.1136/bjophthalmol-2025-egsguidelines on 8 September 2025. Downloaded from http://bjo.bmj.com/ on September 29, 2025 by guest. Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

I.5 What matters to patients

See Fc I

I.5.1 Anxiety associated with glaucoma

The time of first diagnosis - especially when unexpected - is an obvious moment of anxiety for patients, and one which can be mitigated by the provision of support or more information. Empathy with the patient is particularly important when providing a diagnosis; trying to understand what they are thinking and feeling and giving them plenty of opportunity to ask questions and express their fears. The patient may not understand everything at the first consultation, and it may be helpful to repeat information.
Anxiety does not dissipate once the shock of diagnosis has passed: concerns about future deterioration in sight, about ability to hold a driving license, about difficulties with healthcare provision and about age-related difficulty in managing treatment are all common. The perception of disease is likely influenced by family history and how other family members have been affected by glaucoma.
Also, the risk of the patient's own children inheriting the disease is a concern.
A diagnosis of glaucoma is therefore to be confirmed to the patient when full certainty exists. It is essential to clarify what glaucoma suspect and/or ocular hypertension are if that is their case, to avoid unnecessary worry.

I.5.2 The information gap

A lack of information can be a source of anxiety and uncertainty. Not understanding clinical systems, being unable to formulate pertinent questions and feeling undervalued in clinical consultations are all common experiences for patients, which exacerbate the information gap. In contrast, the presence of information can enable engagement in self- care and can support changes in lifestyle which result in a more effective management of glaucoma.

Key information gaps include:

Nature of glaucoma sight loss
Even long-term patients may struggle to understand the nature of glaucoma sight loss. Helping people to understand the specifics of their own field loss can also help them develop techniques to avoid trips and falls. People may assume that surgery or laser will improve vision, so volunteering the correct information is often helpful.

Glaucoma and driving
This is one of the major sources of stress and anxiety for patients, yet there can be confusion about local driving regulations and when a patient may need to notify the authorities. This anxiety is understandable given the potential impact of losing a driving license.

The Guidelines project was entirely supported by the European Glaucoma Society Foundation

Br J Ophthalmol: first published as 10.1136/bjophthalmol-2025-egsguidelines on 8 September 2025. Downloaded from http://bjo.bmj.com/ on September 29, 2025 by guest.
Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

Eye drops

Patients' ability to manage their condition varies depending on their personal circumstances. Drops change, personal circumstances change, attitudes to treatment evolve. Continue checking in with your patients, encourage discussion and frame questions to avoid judgement or censure. E.g. "Do you have any concerns or difficulties with your eye drops"?

Education on eye drop administration is part of the clinical approach. Patients need ongoing information about adherence- not only when their drop regimen changes or when there are supply issues or side effects. Patients need to be encouraged to speak up when they have problems with their drops, and need to know whom to ask for help.

Surgery and laser treatment

The route to making a treatment decision is complex, and many patients need considerable support, advice and time. The possible outcomes and risks of their condition and of the treatment are to be explained in a manner suitable to each individual. Eye surgery is a routine part of our work, but it can sound terrifying for a patient. Providing accurate timely written information for people to take away can mean patients are reassured and empowered to decide and understand the pros and cons of the procedure.

Asking questions is difficult

Patients often find it hard to ask for information from healthcare professionals. Some find the clinical setting is not conducive to engagement, others describe doctors who don't want to engage with them, and many ration their time with their healthcare provider because they feel guilty about using doctors' time. For others, the obstacle lies in not knowing how to frame questions about their glaucoma due to lack of knowledge or difficulties with memory or hearing that inhibits people.

Clinicians should help by inviting questions at every single appointment, encouraging patients to bring written questions with them, or to take along a friend or relative for support.

Glaucoma support groups

These are excellent vehicles for the dissemination of information from a patient's perspective which offer valuable peer support opportunities. Give patients details of local or national support groups, where available, including suggestions about updated and reputable patient information links. Not everyone has access to the internet and if your clinic does not have printed material about glaucoma on hand, perhaps this could be obtained from other organizations.

In summary, patients' information needs are complex – and equally complex for those newly diagnosed as for those diagnosed decades ago. Even patients who appear well focused may lack key information or skills to manage their condition. The healthcare professionals need to be proactive in encouraging questions and providing answers.

The Guidelines project was entirely supported by the European Glaucoma Society Foundation

Br J Ophthalmol: first published as 10.1136/bjophthalmol-2025-egsguidelines on 8 September 2025. Downloaded from http://bjo.bmj.com/ on September 29, 2025 by guest. Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

I.5.3 Tips for doctors

Here is a summary of the top tips presented by the Experts by Experience Committee (a panel of glaucomatous patients) at the Dublin 2024 European Glaucoma Society Congress:

1) Explain to the patient what glaucoma is and its effect on the eyes – please don't assume it is known.
   Explain in simple everyday terms as far as possible and ensure the patient has understood what you're saying before they leave your clinic. Include the form of glaucoma they have and their choices for treatment.
2) Make suggestions you feel are relevant for this patient as to how to live with glaucoma. Let them know about any assistance they could get.
3) Explain well the importance of medical treatment to control eye pressure, and ensure the patient understands that taking the drops and using correct administration techniques will limit further damage, but will not improve vision.
4) Explain clearly how and when to administer eye drops.
   Mention dry eye problems, preservative-free drugs and the possible need to change eye drops over time.
5) Explain the pros and cons of any surgical treatment suggested, including side-effects.
   Also talk about alternative treatments. While prescribing medications provide details regarding the time to administer the specific medication.
6) Address the possible interactions between glaucoma and other health issues the patient may have, including pregnancy for women.
7) Motivate the patient to inform their environment at work and among their circle of friends about their condition.
   Explain how to tell family members, who also might inherit the disease. If a child has glaucoma, allow extra time to talk to family.
8) Inform patients that there are patient organisations, support groups and other good sources of information about glaucoma and how to live with it.

I.5.4 Key points for healthcare providers working with paediatric glaucoma patients

Paediatric glaucoma requires a nuanced approach that combines clinical expertise with a deep understanding of the psychosocial and developmental needs of the child and their caregivers. Doctors should prioritize clear communication, empathetic care, and tailored strategies that address both medical and emotional challenges within the time constraints of clinical practice. Caring for these high demand patients usually is usually done in tertiary centres that have enough volume and expertise. This would provide clinical experience but also a setup that has the required multidisciplinary team to support both child and caregivers.

The Guidelines project was entirely supported by the European Glaucoma Society Foundation

Br J Ophthalmol: first published as 10.1136/bjophthalmol-2025-egsguidelines on 8 September 2025. Downloaded from http://bjo.bmj.com/ on September 29, 2025 by guest.
Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

I.5.4.1 Comprehensive Assessment: Understanding the Whole Picture

Begin with a thorough medical and family history to identify genetic predispositions, consanguinity of parents, associated systemic conditions (e.g., Sturge-Weber syndrome, Axenfeld-Rieger syndrome), and risk factors such as corticosteroid use or ocular trauma. Use age-appropriate assessments to evaluate the child's visual function and developmental impact, asking caregivers about daily challenges and milestones:

Encourage caregivers to share their observations, which often provide valuable insight into the child's condition and adaptation. Caregivers often experience profound anxiety and grief when their child is diagnosed with glaucoma. Interaction with the patient will depend on the patient's age and maturity. Questions can range from social interaction to ability to perform activities in school, among others.
Paediatric glaucoma management often involves a multidisciplinary team. Facilitate access to resources such as vision therapy and mobility training, educational support for children with visual impairments or peer support groups for caregivers to share experiences and strategies and reducing feelings of isolation. Provide caregivers with contact information for national organizations or local resources that can assist with their journey.

Examples of questions to both caregivers and patients:

"How is your child managing tasks like recognizing faces or navigating familiar spaces?" "Are there activities they are struggling with due to their vision?"
"How is the child doing at school?"
"Have you noticed any behavioural changes recently?"
"Do you feel your vision affects your ability to see the board or play sports?"

The Guidelines project was entirely supported by the European Glaucoma Society Foundation

Br J Ophthalmol: first published as 10.1136/bjophthalmol-2025-egsguidelines on 8 September 2025. Downloaded from http://bjo.bmj.com/ on September 29, 2025 by guest.
Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

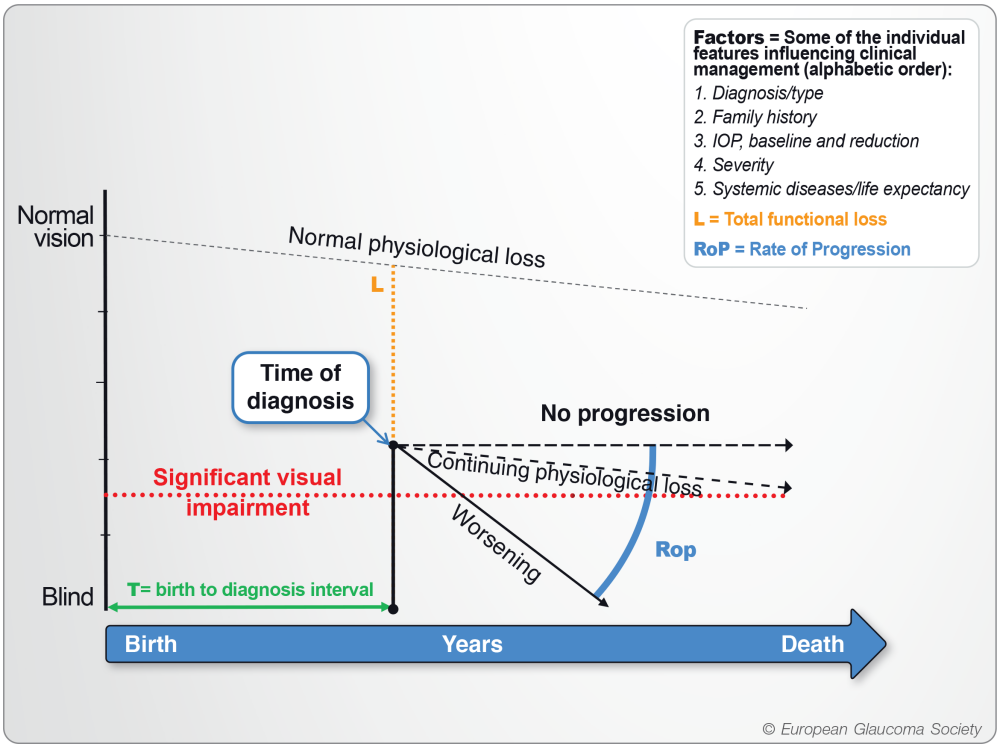


Figure I.6.2 *Evaluation of functional loss/time for individualised treatment.*
L *= difference of visual function between the age-matched normal and the function at the time of diagnosis*
RoP *= angle representing physiological loss and disease progression*
T *= time interval between birth and the time of diagnosis*

The Guidelines project was entirely supported by the European Glaucoma Society Foundation

Br J Ophthalmol: first published as 10.1136/bjophthalmol-2025-egsguidelines on 8 September 2025. Downloaded from http://bjo.bmj.com/ on September 29, 2025 by guest.
Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

I.6 Glaucoma epidemiology

Glaucoma is a leading cause of vision impairment and is globally the most common cause of irreversible blindness.[1,2] Early epidemiological studies focused on predominantly Caucasian populations in higher income countries. More recent population-based studies have provided data for broader regions which have enabled more accurate modelling of the prevalence and morbidity of the disease.[3-9] As more countries undergo their epidemiological transition,[10] the burden of glaucoma worldwide is likely to increase significantly over the coming decades. This will require significant development of resources and technology to ensure healthcare access for all those that require it. Several ocular and systemic risk factors have been well established for glaucoma. Future research may help elucidate additional risk factors and enable a more precise quantification of the relative contribution of each to glaucoma susceptibility. Furthermore, advances in the genetic characterization of glaucoma may enhance the accuracy of individualized risk stratification.

I.6.1 Burden of glaucoma

The most prevalent form of glaucoma is primary open angle glaucoma (POAG) with an estimated global prevalence in adults aged 40 to 80 years of 3.05% (95% I, 1.69-5.27).[11] Using data from 14 population based studies, 2.99% (12.3 million) of the European population aged 40+ years are estimated to have glaucoma, and more than half (56.4%) of cases undiagnosed.[12] Conversely, there are very limited data on the overdiagnosis and overtreatment of POAG, which is also expected to occur in clinical practice. The Thessaloniki Eye Study reported that the overdiagnosis of POAG is substantial in an elderly white European population.[13] By 2050, one further million cases are anticipated in Europe due to aging population.[12]

Glaucoma is estimated to be responsible for between 11-14% of all cases of blindness, globally[1,2] and 26% of those blind indifiduals are in high income countries.[2] In 2020, 279,000, 1,350,000 and 681,000 people were estimated blind due to glaucoma in Central, Western and Eastern Europe, respectively. Subjects with visual impairment by glaucoma in these regions numbered 3,269,000, 11,055,000 and 8,943,000, respectively. Between years 2000 and 2020, age-standardised prevalence of glaucoma blindness decreased in Central, Western and Eastern Europe, by 14%, 11% and 26%, respectively, while decreases in moderate and severe vision impairment were more modest (2%; 1%; 2%).[1]

I.6.2 Natural history of glaucoma and blindness

While OAG is far more common than ACG, blindness is more likely to happen in ACG than in OAG (estimated 25% and 10% over the patient lifetime, respectively). Due to the established benefit of IOP-lowering treatment in glaucoma, there have been very few opportunitities to study the course of untreated glaucoma over time. Valuable data on the natural course of OAG have also been provided by the Early Manifest Glaucoma Trial (EMGT, see 1.7.1.3), the United Kingdom Glaucoma Treatment Study

The Guidelines project was entirely supported by the European Glaucoma Society Foundation

Br J Ophthalmol: first published as 10.1136/bjophthalmol-2025-egsguidelines on 8 September 2025. Downloaded from http://bjo.bmj.com/ on September 29, 2025 by guest. Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

(UKGTS, see 1.7.1.5) and the Collaborative Normal-Tension Glaucoma Study (CNTGS, see 1.7.1.1). In the untreated arm of the EMGT, the overall natural rate of progression in the VF was 1.08 dB/year. Participants with different disease phenotypes exhibited different rates of progression (1.31 dB/year in high tension glaucoma, 0.36 dB/year in normal tension glaucoma and 3.13 dB/year in pseudoexfoliative glaucoma (PXFG).[21] See Fig. I.6.2.

I.6.3 Risk factors for glaucoma

Several risk factors for glaucoma have been long established with age and IOP remaining the most significant.[11 21] Non-White ethnicity (particularly Black), family history of glaucoma, pseudoexfoliation, disc haemorrhage, thinner cornea and myopia have been reported as major risk factors for the development and/or progression of OAG.[22-24] The highest prevalence of PACG appears in East-Asian and Chinese ethnicities.[11]

There is continuing research into further ocular and systemic risk factors for glaucoma with an aim to provide the most accurate risk stratification tools for clinicians. There has been significant interest in corneal biomechanical properties in recent years, although the pathophysiological mechanism by which they increase glaucoma risk remains unclear. Further investigations into systemic risk factors continues. Studies have often found conflicting evidence regarding these, for example with diabetes mellitus and obstructive sleep apnoea.

There is increasing evidence supporting the role of blood pressure. In particular, several prevalence and incidence studies reported that low diastolic blood pressure is associated with increased risk for glaucoma. Some of those studies revealed a potential role of antihypertensive treatment in combination with lowered diastolic blood pressure.[25-26]

I.6.4 The future of glaucoma management and policy implications

As more countries worldwide experience an epidemiological transition towards increasing mean age the number of patients with glaucoma will significantly rise over the coming decades. Regions with the highest prevalence of glaucoma often have the most limited healthcare resources. To meet this growing demand there will need to be efficient utility of resources, improved access to care, and improved awareness of the disease.[25] This will require adequate workforce planning globally to provide the ophthalmologists and non-ophthalmologist healthcare professionals to care for these patients.

Technologies which enable remote consultation and monitoring may alleviate shortages of healthcare professionals. With greater refinement, mobile applications which enable the home assessment of visual acuity and visual field may enable a large degree of home monitoring. Furthermore, the development of screening programmes may help target healthcare resources to those with greatest need and greater risk.

Ongoing research into ocular and systemic risk factors may help develop a significantly improved degree of individual risk stratification in the future. Finally, further understanding of the genetics of the condition may significantly increase our ability to determine individual risk and response to therapies as glaucoma management enters the age of personalised medicine. See Ch I.5 and I.6.

The Guidelines project was entirely supported by the European Glaucoma Society Foundation

Br J Ophthalmol: first published as 10.1136/bjophthalmol-2025-egsguidelines on 8 September 2025. Downloaded from http://bjo.bmj.com/ on September 29, 2025 by guest. Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

- **Thanks to many recent well-conducted population-based studies in Europe we now have a much better understanding of glaucoma prevalence and underdiagnosis, which cannot be captured with studies based on hospital/clinic/volunteers.**
- **Age-standardised prevalence of glaucoma blindness and vision impairment has decreased over the last 20 years in Europe. Although this is to be welcomed, the epidemiological transition, that includes changing age structure, means that glaucoma cases will continue to increase.**
- **Meeting current and future needs requires the efficient use of resources, enhanced access to care, greater disease awareness, and the adoption of personalized medicine.**

References:

1. GBD 2019 Blindness and Vision Impairment Collaborators; Vision Loss Expert Group of the Global Burden of Disease Study. Causes of blindness and vision impairment in 2020 and trends over 30 years, and prevalence of avoidable blindness in relation to VISION 2020: the Right to Sight: an analysis for the Global Burden of Disease Study. Lancet Glob Health. Feb 2021;9(2):e144-e160.
2. Vision Loss Expert Group of the Global Burden of Disease Study and the GBD 2019 Blindness and Vision Impairment Collaborators. Global estimates on the number of people blind or visually impaired by glaucoma: A meta-analysis from 2000 to 2020. Eye 2024; 38: 2036–2046.
3. McCann P, Hogg R, Wright DM, Pose-Bazarra S, Chakravarthy U, Peto T, et al. Glaucoma in the Northern Ireland Cohort for the Longitudinal Study of Ageing (NICOLA): cohort profile, prevalence, awareness and associations. Br J Ophthalmol. 2020;104(11):1492–9.
4. Springelkamp H, Wolfs RC, Ramdas WD, Hofman A, Vingerling JR, Klaver CC, et al. Incidence of glaucomatous visual field loss after two decades of follow-up: the Rotterdam Study. Eur J Epidemiol. 2017;32(8):691–9.
5. Topouzis F, Wilson MR, Harris A, Anastasopoulos E, Yu F, Mavroudis L, et al. Prevalence of open- angle glaucoma in Greece: the Thessaloniki Eye Study. Am J Ophthalmol. 2007;144(4):511–9.
6. Chan MPY, Broadway DC, Khawaja AP, Yip JLY, Garway-Heath DF, Burr JM, et al. Glaucoma and intraocular pressure in EPIC-Norfolk Eye Study: cross sectional study. BMJ. 2017;358:j3889.
7. Höhn R, Nickels S, Schuster AK, Wild PS, Münzel T, Lackner KJ, et al. Prevalence of glaucoma in Germany: results from the Gutenberg Health Study. Graefes Arch Clin Exp Ophthalmol. 2018;256(9):1695–702.
8. Arnould L, De Lazzer A, Seydou A, Binquet C, Bron AM, Creuzot-Garcher C. Diagnostic ability of spectral-domain optical coherence tomography peripapillary retinal nerve fiber layer thickness to discriminate glaucoma patients from controls in an elderly population (The MONTRACHET study). Acta Ophthalmol. 2020;98(8):e1009–16.
9. Bikbov MM, Gilmanshin TR, Zainullin RM, Kazakbaeva GM, Arslangareeva II, Panda-Jonas S, et al. Prevalence and associated factors of glaucoma in the Russian Ural Eye and Medical Study. Sci Rep. 2020;10(1):1–14.
10. Omran AR. The epidemiologic transition. A theory of the epidemiology of population change. Milbank Mem Fund Q 1971; 49: 509-38.
11. Tham YC, Li X, Wong TY, Quigley HA, Aung T, Cheng CY. Global prevalence of glaucoma and projections of glaucoma burden through 2040: a systematic review and meta-analysis. Ophthalmology. Nov 2014;121(11):2081-90. doi:10.1016/j.ophtha.2014.05.013.

The Guidelines project was entirely supported by the European Glaucoma Society Foundation

Br J Ophthalmol: first published as 10.1136/bjophthalmol-2025-egsguidelines on 8 September 2025. Downloaded from http://bjo.bmj.com/ on September 29, 2025 by guest. Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

12. Stuart KV, Ramdas W, Schweitzer C, Schuster AK, Jansonius NM, de Vries V, et al. The Prevalence of Glaucoma in Europe: The European Eye Epidemiology (E3) Consortium. Poster presentation at: American Academy of Ophthalmology Annual Meeting (AAO 2023). 3–6 November 2023; San Francisco, CA, USA.Rasendran C, Li A, Singh RP.
13. Founti P, Coleman AL, Wilson MR, Yu F, Anastasopoulos E, Harris A, Pappas T, Koskosas A, Kilintzis V, Salonikiou A, Raptou A, Topouzis F. Overdiagnosis of open angle glaucoma in the general population: the Thessaloniki Eye Study. Acta Ophthalmol 2018;96:e859-e864.
14. Incremental Health Care Expenditures Associated With Glaucoma in the United States: A Propensity Score-matched Analysis. J Glaucoma. Nov 12 2021;doi:10.1097/ ijg.0000000000001957.
15. Iskedjian M, Walker J, Vicente C, et al. Cost of glaucoma in Canada: analyses based on visual field and physician's assessment. J Glaucoma. Dec 2003;12(6):456-62. doi:10.1097/00061198-200312000-00002.
16. Shih V, Parekh M, Multani JK, et al. Clinical and Economic Burden of Glaucoma by Disease Severity: A United States Claims-Based Analysis. Ophthalmol Glaucoma. Sep-Oct 2021;4(5):490-503. doi:10.1016/j.ogla.2020.12.007.
17. Patel AR, Schwartz GF, Campbell JH, et al. Economic and Clinical Burden Associated With Intensification of Glaucoma Topical Therapy: A US Claims-based Analysis. J Glaucoma. Mar 1 2021;30(3):242-250. doi:10.1097/ijg.0000000000001730.
18. Purola PKM, Taipale J, Väätäinen S, Harju M, Koskinen SVP, Uusitalo HMT. Price tag of glaucoma care is minor compared with the total direct and indirect costs of glaucoma: Results from nationwide survey and register data. PLoS One. 2023 Dec 20;18(12):e0295523. doi: 10.1371/journal.pone.0295523. PMID: 38117760; PMCID: PMC10732367.
19. Rouland JF, Berdeaux G, Lafuma A. The economic burden of glaucoma and ocular hypertension: implications for patient management: a review. Drugs Aging. 2005;22(4):315-21. doi: 10.2165/00002512-200522040-00004. PMID: 15839720.
20. CE Traverso, J G Walt, S P Kelly, A H Hommer, A M Bron, P Denis, J-P Nordmann, J-P Renard, A Bayer, F Grehn, N Pfeiffer, C Cedrone, S Gandolfi, N Orzalesi, C Nucci, L Rossetti, A Azuara- Blanco, A Bagnis, R Hitchings, J F Salmon, G Bricola, P M Buchholz, S V Kotak, L M Katz, L R Siegartel, J J Doyle. Direct costs of glaucoma and severity of the disease: a multinational long term study of resource utilisation in Europe. Br J Ophthalmol 2005;89:1245–1249.
21. Hejil A, Bengtsson B, Human L, Leske MC. Natural history of open angle glaucoma. Ophthalmology 2009; 116:2271-76.
22. Topouzis F, Coleman AL, Harris A, Koskosas A, Founti P, Gong G, Yu F, Anastasopoulos E, Pappas T, Wilson MR. Factors associated with undiagnosed open-angle glaucoma: the Thessaloniki Eye Study. Am J Ophthalmol. 2008 Feb;145(2):327-335.
23. Schuster AK, Wagner FM, Pfeiffer N, Hoffmann EM. Risk factors for open-angle glaucoma and recommendations for glaucoma screening. Ophthalmologe 2021. 118 (Suppl 2):S145–S152.
24. Day AC, Baio G, Gazzard G, et al. The prevalence of primary angle closure glaucoma in European derived populations: a systematic review. Br J Ophthalmol 2012;96:1162-67.
25. Topouzis F, Harris A, Wilson MR, Koskosas A, Founti P, Yu F, Anastasopoulos E, Pappas T, Coleman AL. Increased likelihood of glaucoma at the same screening intraocular pressure in subjects with pseudoexfoliation: the Thessaloniki Eye Study. Am J Ophthalmol 2009;148:606-613.
26. Arch Ophthalmol.2002 Jul;120(7):954-9.doi: 10.1001/archopht.120.7.95.

The Guidelines project was entirely supported by the European Glaucoma Society Foundation

Br J Ophthalmol: first published as 10.1136/bjophthalmol-2025-egsguidelines on 8 September 2025. Downloaded from http://bjo.bmj.com/ on September 29, 2025 by guest.
Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

27. Am J Ophthalmol. 2013 May;155(5):843-51. doi: 10.1016/j.ajo.2012.12.007. Epub 2013 Feb 6.PMID: 23394905, Barbados etc.
28. Burr JM, Mowatt G, Hernandez E, et al. The clinical and cost-effectiveness of screening for open angle glaucoma: a systematic review and economic evaluation. Health Technol Assess 2007;11(41):iii-190.
29. Hennis A, Wu SY, Nemesure B, Honkanen R, Leske MC; Barbados Eye Studies Group. Awareness of incident open-angle glaucoma in a population study: the Barbados Eye Studies. Ophthalmology. 2007 Oct;114(10):1816-21. doi: 10.1016/j.ophtha.2007.06.013. Epub 2007 Aug 15. PMID: 17698198.30

Br J Ophthalmol: first published as 10.1136/bjophthalmol-2025-egsguidelines on 8 September 2025. Downloaded from http://bjo.bmj.com/ on September 29, 2025 by guest.
Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

The Guidelines project was entirely supported by the European Glaucoma Society Foundation

I.7 Landmark randomised controlled trials for glaucoma

In the following pages we briefly summarize results from some high quality prospective randomised controlled trials for glaucoma and derive comments relevant to clinical decision-making. Clinical care should be individualised and guided by evidence. Landmark Randomised Controlled Trials provide helpful information for clinical recommendations. The cost-effectveness of management options should also be considered by physicians, in order to provide sustainable healthcare.

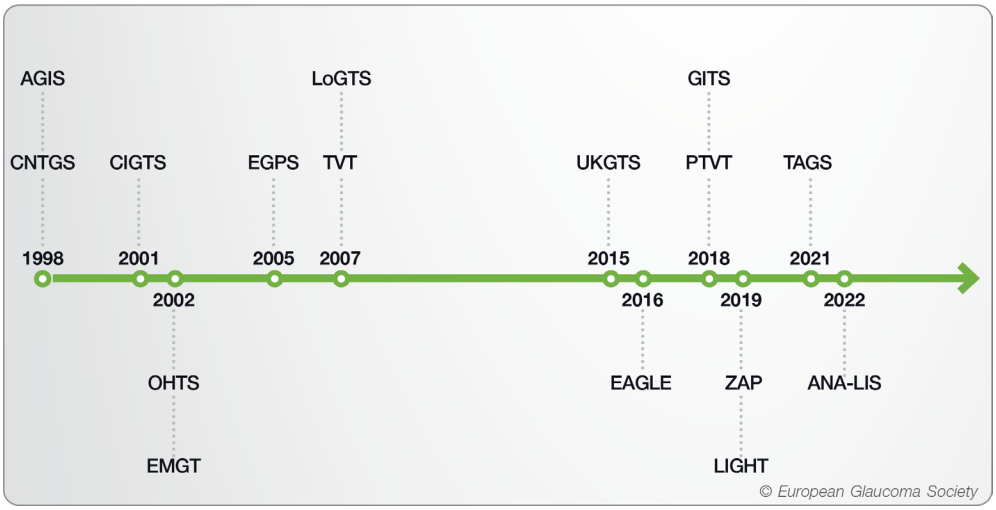


Figure I.7.1 *Landmark randomised controlled trials for glaucoma and year of first published results.*

I.7.1 Treatment vs no treatment trials in open angle glaucoma

I.7.1.1 Collaborative normal tension glaucoma study (CNTGS)

The CNTGS compared treatment versus no treatment in normal tension glaucoma in a multi-centre, randomised trial. 230 eligible patients entered the study. Only those who exhibited verified progression of visual field (VF) loss or threat to fixation were randomised (n=140). The primary outcome measure was disease progression as evident from VF or stereo disc photographs.[1]

Summary of results:[2-5]

- A 30% intraocular pressure (IOP) reduction from baseline was the treatment goal and was maintained in nearly 50% of patients. Progression occurred in 12% (7/61) of treated eyes and 35% (28/79) of controls.
- In the intent-to-treat analysis no benefit of treatment was found.
- A beneficial effect of IOP lowering was found only after the data were censored for the effect of cataract formation on the VF.
- Cataracts were more common in patients treated with surgery.

The Guidelines project was entirely supported by the European Glaucoma Society Foundation

Br J Ophthalmol: first published as 10.1136/bjophthalmol-2025-egsguidelines on 8 September 2025. Downloaded from http://bjo.bmj.com/ on September 29, 2025 by guest. Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

– Progression rates varied widely. The mean rate of worsening was 0.41 dB/year in the untreated arm. Prior documented progression did not increase the risk of future progression.

References:

1. Group CNTGS. Comparison of glaucomatous progression between untreated patients with normal-tension glaucoma and patients with therapeutically reduced intraocular pressures. Am J Ophthalmol 1998;126(4):487-97.
2. Group CNTGS. The effectiveness of intraocular pressure reduction in the treatment of normal- tension glaucoma. Am J Ophthalmol 1998;126(4):498-505.
3. Drance S, Anderson DR, Schulzer M. Risk factors for progression of visual field abnormalities in normal-tension glaucoma. Am J Ophthalmol 2001;131(6):699-708.
4. Anderson DR, Drance SM, Schulzer M. Factors that predict the benefit of lowering intraocular pressure in normal tension glaucoma. Am J Ophthalmol 2003;136(5):820-29.
5. Anderson DR, Drance SM, Schulzer M. Natural history of normal-tension glaucoma. Ophthalmology 2001;108(2):247-53.

I.7.1.2 The Ocular Hypertension Treatment Study (OHTS)

The OHTS was a multicentre, randomised, clinical trial, designed to study the effect of topical medication in delaying or preventing the onset of glaucoma in patients with ocular hypertension (OHT). A total of 1636 patients were recruited. Randomisation was between treatment with medications and no treatment. The treatment goal was to lower the IOP to less than 24 mmHg and at least 20% from baseline. The primary outcome was the development of primary open angle glaucoma (POAG) defined as reproducible VF defects or reproducible optic disc deterioration. After the 5-year initial results were reported the control group received treatment.[1]

Summary of results:[2-6]

– Mean IOP reduction was 22.5% in the treated group. The control group showed a decrease of IOP of 4.0%.
– After 5 years, 4.4% of patients in the treated group had developed signs of glaucoma damage versus 9.5% in controls ($p < 0.0001$), a 50% reduction of relative risk.
– In addition, more than 90% of untreated patients had not converted to glaucoma after 5 years.
– After 13 years (OHTS-II) 22% of patients who had initially been randomised to the control group with no treatment and received treatment after a median of 7.5 years, had converted to glaucoma versus 16% in the group that was treated at the start of the study. However, delaying treatment did not result in higher rates of conversion to glaucoma except in patients presenting with a higher baseline risk for conversion exceeding 13%.
– POAG conversion was detected first in disc photographs in around 50% of patients and by field testing in approximately 40%.
– Risk factors for development of glaucoma were: thinner CCT, higher IOP, disc haemorrhages, older age, larger vertical and horizontal CDR, greater VF pattern standard deviation (PSD).

The Guidelines project was entirely supported by the European Glaucoma Society Foundation

Br J Ophthalmol: first published as 10.1136/bjophthalmol-2025-egsguidelines on 8 September 2025. Downloaded from http://bjo.bmj.com/ on September 29, 2025 by guest. Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

- Disc haemorrhages detectable in photographs had been missed at 87% of clinical examinations. Rate of conversion was higher in eyes with haemorrhages.
- A risk calculator is freely available to estimate the risk of developing glaucoma at 5 years. *https://ohts.wustl.edu/risk/*
- Cataract formation was more common in the medication group.
- Collectively, analysis of VF data from OHTS studies revealed that some patients may experience more rapid progression than others.[8]

References:

1. Gordon MO, Kass MA. The Ocular Hypertension Treatment Study: design and baseline description of the participants. Arch Ophthalmol 1999;117(5):573-83.
2. Kass MA, Heuer DK, Higginbotham EJ, et al. The Ocular Hypertension Treatment Study: a randomised trial determines that topical ocular hypotensive medication delays or prevents the onset of primary open angle glaucoma. Arch Ophthalmol 2002;120(6):701-13; discussion 829-30.
3. Kass MA, Gordon MO, Gao F, et al. Delaying treatment of ocular hypertension: the ocular hypertension treatment study. Arch Ophthalmol 2010;128(3):276-87.
4. Keltner JL, Johnson CA, Anderson DR, et al. The association between glaucomatous visual fields and optic nerve head features in the Ocular Hypertension Treatment Study. Ophthalmology 2006;113(9):1603-12.
5. Budenz DL, Anderson DR, Feuer WJ, et al. Detection and prognostic significance of optic disc hemorrhages during the Ocular Hypertension Treatment Study. Ophthalmology 2006;113(12):2137-43.
6. Herman DC, Gordon MO, Beiser JA, et al. Topical ocular hypotensive medication and lens opacification: evidence from the ocular hypertension treatment study. Am J Ophthalmol 2006;142(5):800-10.
7. Kass et al Archives 2010, Delaying treatment of ocular hypertension. The Ocular Hypertension Treatment Study.
8. Gordom MO et al. Visual Field Progression in the Ocular Hypertension Treatment Study. Am J Ophthalmol 2025; 271:360-370.

I.7.1.3 The Early Manifest Glaucoma Trial (EMGT)

The EMGT was a randomised, prospective trial comparing treatment versus no treatment to evaluate the effectiveness of IOP reduction in early, previously untreated open angle glaucoma.[1] Secondary aims were to assess factors related to glaucoma progression and to determine the natural history of the disease.

During a population-based screening among 44,243 residents in Sweden, 316 eyes of 255 patients were recruited between 1993 and 1997, and followed prospectively until December 31, 2013. Treated patients received a standardised treatment protocol of laser trabeculoplasty and topical betaxolol. Treatment or no-treatment remained unchanged as long as definite progression had not occurred. Primary outcome measure was progression of disease, defined by sustained VF deterioration or optic disc changes.

Summary of results:[2-18]

- This study was the first to prove and quantify the value of IOP reduction in patients with POAG, normal tension glaucoma (NTG) and pseudoexfoliative glaucoma (PXFG).

The Guidelines project was entirely supported by the European Glaucoma Society Foundation

Br J Ophthalmol: first published as 10.1136/bjophthalmol-2025-egsguidelines on 8 September 2025. Downloaded from http://bjo.bmj.com/ on September 29, 2025 by guest. Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

- A 25% decrease in IOP from baseline (mean untreated IOP 20.6 mmHg) reduced the relative risk of progression by 50%.
- Risk of progression was smaller with lower baseline IOP values and with a larger initial IOP drop induced by treatment.
- Treatment efficacy in terms of IOP reduction depended very much on pre-treatment IOP.
- Important risk factors for progression were: higher IOP, pseudoexfoliative syndrome (PXF), more baseline damage, higher age, disc haemorrhages, thinner CCT in high tension glaucoma, and low blood pressure in NTG.
- IOP fluctuation was not a risk factor for progression.
- IOP did not increase but remained constant over time in untreated eyes with POAG but increased over time in eyes with PXFG.
- Increase in lens opacity occurred more in the treatment arm than in the control arm.
- There was no evidence of VF improvement on initiation of glaucoma therapy.
- Disease progression rates varied substantially between individual patients.
- Untreated progression rates (natural history) were slower in NTG (-0.36 dB/year), faster in high tension glaucoma (-1.31 dB/year), and even faster in eyes with PXFG (-3.10 dB/year).
- Definite progression was associated with a mean worsening of mean defect (MD) of less than 2dB.
- In eyes with manifest glaucoma, progression in the VF was detected first more than 4 times as often as progression in the optic disc. Among fellow eyes without VF loss at baseline, progression was detected first as frequently in the optic disc as in the VF. Perimetric progression was detected first at all stages of the disease.
- After a few years of follow-up, vision-related quality of life (QoL) did not differ between treatment arms, i.e. the absence or presence of treatment did not influence QoL. An analysis after 20 years of follow-up supports the widespread, albeit arbitrary, use of a better-eye remaining VFI loss greater than 50% or MD worse than -18 dB as an important threshold for a significant reduction in vision-related QoL.
- The frequency of disc haemorrhages was higher with lower IOP, in women and with myopia and was not influenced by treatment.
- An analysis of EMGT patients followed for at least 15 years showed that a glaucoma diagnosis made by applying strict criteria to 2 initial VF tests, supported by optic disc findings if VF findings were borderline, was almost always correct.

References:

1. Leske MC, Heijl A, Hyman L, Bengtsson B. Early Manifest Glaucoma Trial: design and baseline data. Ophthalmology 1999;106(11):2144-53.
2. Heijl A, Leske MC, Bengtsson B, et al. Reduction of intraocular pressure and glaucoma progression: results from the Early Manifest Glaucoma Trial. Arch Ophthalmol 2002;120(10):1268-79.
3. Leske MC, Heijl A, Hussein M, et al. Factors for glaucoma progression and the effect of treatment: the Early Manifest Glaucoma Trial. Arch Ophthalmol 2003;121(1):48-56.
4. Heijl A, Leske MC, Hyman L, et al. Intraocular pressure reduction with a fixed treatment protocol in the Early Manifest Glaucoma Trial. Acta Ophthalmol 2011;89(8):749-54.
5. Heijl A, Peters D, Leske MC, Bengtsson B. Effects of argon laser trabeculoplasty in the Early Manifest Glaucoma Trial. Am J Ophthalmol 2011;152(5):842-48.
6. Leske MC, Heijl A, Hyman L, et al. Predictors of long-term progression in the early manifest glaucoma trial. Ophthalmology 2007;114(11):1965-72.

The Guidelines project was entirely supported by the European Glaucoma Society Foundation

Br J Ophthalmol: first published as 10.1136/bjophthalmol-2025-egsguidelines on 8 September 2025. Downloaded from http://bjo.bmj.com/ on September 29, 2025 by guest. Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

7. Bengtsson B, Leske MC, Hyman L, Heijl A. Fluctuation of intraocular pressure and glaucoma progression in the early manifest glaucoma trial. Ophthalmology 2007;114(2):205-09.
8. Hyman L, Heijl A, Leske MC, et al. Natural history of intraocular pressure in the early manifest glaucoma trial: A 6-year follow-up. Arch Ophthalmol 2010;128(5):601-07.
9. Bengtsson B, Heijl A. Lack of visual field improvement after initiation of intraocular pressure reducing treatment in the Early Manifest Glaucoma Trial. Invest Ophthalmol Vis Sci 2016;57(13):5611-15.
10. Heijl A, Bengtsson B, Hyman L, Leske MC. Natural history of open angle glaucoma. Ophthalmology 2009;116(12):2271-76.
11. Heijl A, Bengtsson B, Chauhan BC, et al. A comparison of visual field progression criteria of 3 major glaucoma trials in early manifest glaucoma trial patients. Ophthalmology 2008;115(9):1557-65.
12. Heijl A, Leske MC, Bengtsson B, Hussein M. Measuring visual field progression in the Early Manifest Glaucoma Trial. Acta Ophthalmol Scand 2003;81(3):286-93.
13. Öhnell H, Heijl A, Brenner L, Anderson H, Bengtsson B. Structural and functional progression in the Early Manifest Glaucoma Trial. Ophthalmology 2016;123(6):1173-80.
14. Öhnell H, Heijl A, Anderson H, Bengtsson B. Detection of glaucoma progression by perimetry and optic disc photography at different stages of the disease: results from the Early Manifest Glaucoma Trial. Acta Ophthalmol 2017;95(3):281-87.
15. Hyman LG, Komaroff E, Heijl A, et al. Treatment and vision-related quality of life in the early manifest glaucoma trial. Ophthalmology 2005;112(9):1505-13.
16. Peter D, Heijl A, Brenner L, Bengtsson B. Visual impairment and vision-related quality of life in the Early Manifest Glaucoma Trial after 20 years of follow-up. Acta Ophthalmol 2015;93(8):745-52.
17. Bengtsson B, Leske MC, Yang Z, Heijl A. Disc hemorrhages and treatment in the early manifest glaucoma trial. Ophthalmology 2008;115(11):2044-48.
18. Öhnell H, Bengtsson B, Heijl A. Making a correct diagnosis of glaucoma: Data from EMGT. J Glaucoma 2019; 28(10):859-64

I.7.1.4 European Glaucoma Prevention Study (EGPS)

The EGPS was a multicentre, randomised, double-masked, placebo-controlled clinical trial. The aim of this study was to evaluate the efficacy of IOP reduction with dorzolamide in preventing glaucoma damage in patients with OHT. The patients were randomised into 2 groups: active therapy (topical dorzolamide) and placebo. Main outcome measures were VF and/or optic disc changes.[1]

Summary of results:[2-6]

- 1081 patients were enrolled. The median duration of follow-up was 55 months.
- The IOP difference between the treatment and the control group was small. The mean IOP reduction was 15% after 6 months and 22% after 5 years in the dorzolamide group, but there was also a 9% reduction after 6 months and 19% after 5 years in the placebo group, to a large part attributable to high attrition.
- The study failed to detect a statistically significant difference between the chosen medical therapy and placebo, either in IOP lowering effect, or in the rate of progression to POAG, and attrition was large.
- The same predictors for the development of POAG were identified independently in both the OHTS observation group and the EGPS placebo group: baseline older

The Guidelines project was entirely supported by the European Glaucoma Society Foundation

Br J Ophthalmol: first published as 10.1136/bjophthalmol-2025-egsguidelines on 8 September 2025. Downloaded from http://bjo.bmj.com/ on September 29, 2025 by guest.
Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

age, higher IOP, thinner central corneal thickness (CCT), larger vertical cup/disc ratio (CDR), and higher Humphrey VF PSD. Diuretics use was pointed as a possible risk factor.
– In a later paper, several baseline Heidelberg retina tomograph (HRT) parameters, alone or in combination with baseline clinical and demographic factors, were significantly associated with the development of open angle glaucoma among the EGPS participants.

References:

1. Miglior S, Zeyen T, Pfeiffer N, et al. The European glaucoma prevention study design and baseline description of the participants. Ophthalmology 2002;109(9):1612-21.
2. Miglior S, Zeyen T, Pfeiffer N, et al. Results of the European Glaucoma Prevention Study. Ophthalmology 2005;112(3):366-75.
3. Miglior S, Pfeiffer N, Torri V, et al. Predictive factors for open angle glaucoma among patients with ocular hypertension in the European Glaucoma Prevention Study. Ophthalmology 2007;114(1):3-9.
4. Miglior S, Torri V, Zeyen T, et al. Intercurrent factors associated with the development of open angle glaucoma in the European glaucoma prevention study. Am J Ophthalmol 2007;144(2):266-75.
5. Hoffmann EM, Miglior S, Zeyen T, et al. The Heidelberg retina tomograph ancillary study to the European glaucoma prevention study: study design and baseline factors. Acta Ophthalmol 2013;91:612-19.
6. Miglior S, Zeyen T, Hoffmann T, et al. Predictive value of heidelberg retina tomograph parameters for the development of glaucoma in the European glaucoma prevention study. Am J Ophthalmol 2015;159:265-76.

I.7.1.5 United Kingdom Glaucoma Treatment Study (UKGTS)

The UKGTS was a multicentre, randomised, masked, placebo-controlled trial designed to assess visual function preservation in open angle glaucoma (OAG) patients given latanoprost 0.005% compared with those given placebo. 516 individuals were enrolled. The primary outcome was time to VF deterioration within 24 months. Progression was measurable within such a time frame since the frequency of VF examination was increased. This placebo-controlled trial is the only one to quantify VF preservation with a single IOP-lowering drug in patients with OAG, in this case a prostaglandin.[1]

Summary of results:[2-6]

– Untreated IOP was 19.6 ± 4.6 mmHg and 20.1 ± 4.8 mmHg in the latanoprost group and in the placebo group, respectively.
– Mean reduction in IOP was 3.8 ± 4.0 mmHg in the latanoprost group and 0.9 ± 3.8 mmHg in the placebo group.
– 25.6% patients in the placebo group reached the VF deterioration endpoint at 24 months compared with 15.2% in the latanoprost group.
– The 20% reduction in IOP in the latanoprost group, from a baseline of 19.6 mmHg, was associated with significantly longer VF preservation than in the placebo group (HR: 0.44).
– The risk of progression increased by 7% per mmHg higher baseline IOP, by 59% if both eyes of a patient had glaucoma, and was double if baseline disc haemorrhage was present.

The Guidelines project was entirely supported by the European Glaucoma Society Foundation

Br J Ophthalmol: first published as 10.1136/bjophthalmol-2025-egsguidelines on 8 September 2025. Downloaded from http://bjo.bmj.com/ on September 29, 2025 by guest. Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

- Patient age, severity of VF loss, and IOP fluctuations were not associated with risk of progression.
- QoL was not different between treatment arms. The Patient Reported Outcomes (PROM's) used were not sensitive enough to function as primary endpoints for this trial.
- Faster rates of retinal nerve fibre layer thinning, measured by optical coherence tomography (OCT), was associated with a greater risk of VF progression.
- VF change in the first 3 months was no different between treatment and placebo arms.
- Combining VF and OCT data identified progression more quickly than using only VF data.

References:

1. Lascaratos G, Garway-Heath DF, Burton R, et al. The United Kingdom Glaucoma Treatment Study: a multicenter, randomised, double-masked, placebo-controlled trial: baseline characteristics. Ophthalmology 2013;120:2540-45.
2. Garway-Heath DF, Crabb DP, Bunce C, et al. Latanoprost for open angle glaucoma (UKGTS): a randomised, multicentre, placebo-controlled trial. Lancet 2015;385:1295-1304.
3. Garway-Heath DR, Zhu H, Cheng Q, et al. Combining Optical Coherence Tomography With Visual Field Data to Rapidly Detect Disease Progression in Glaucoma: A Diagnostic Accuracy Study Health Technol Assess 2018 Jan;22(4):1-106.
4. Founti P, Bunce C, Khawaja AP, et al. Risk factors for visual field deterioration in the United Kingdom Glaucoma Treatment Study [published online ahead of print, 2020 Jun 12]. Ophthalmology 2020;S0161-6420(20)30527-3.
5. Jones L, Garway-Heath DF, Azuara-Blanco A, Crabb DP; United Kingdom Glaucoma Treatment Study Investigators. Are Patient Self-Reported Outcome Measures Sensitive Enough to Be Used as End Points in Clinical Trials?: Evidence from the United Kingdom Glaucoma Treatment Study. Ophthalmology 2019;126:682-89.
6. Rabiolo A, Montesano G, Crabb DP, Garway-Heath DF; United Kingdom Glaucoma Treatment Study Investigators. Relationship between Intraocular Pressure Fluctuation and Visual Field Progression Rates in the United Kingdom Glaucoma Treatment Study. Ophthalmology. 2024 Aug;131(8):902-913. doi: 10.1016/j.ophtha.2024.02.008. Epub 2024 Feb 13. PMID: 38354911.
7. Montesano G, Rabiolo A, Ometto G, Crabb DP, Garway-Heath DF. Relationship Between Intraocular Pressure and the True Rate of Functional and Structural Progression in the United Kingdom Glaucoma Treatment Study. Invest Ophthalmol Vis Sci. 2025 Jan 2;66(1):32. doi: 10.1167/iovs.66.1.32. PMID: 39808119; PMCID: PMC11737456.
8. Reddingius P, Kelly SR, Ometto G, Garway-Heath DF, Crabb DP; United Kingdom Treatment Investigators. Does the visual field improve after initiation of intraocular pressure lowering in the United Kingdom Treatment study? AM J Ophthalmol 2025 Jan:269;346-54. .

I.7.2 Treatment vs no treatment trials on angle closure

I.7.2.1 Zhongshan Angle Closure Prevention study (ZAP)

The ZAP was a single-centre, randomised controlled trial designed to evaluate the efficacy of laser peripheral iridotomy (LPI) in preventing primary angle closure (PAC) or acute angle closure (AAC), in primary angle closure suspects (PACS). After a population-based screening involving 11991 participants, 889 untreated Chinese PACS, defined as iridotrabecular contact of at least 180 degrees without peripheral anterior synechiae (PAS) or

The Guidelines project was entirely supported by the European Glaucoma Society Foundation

Br J Ophthalmol: first published as 10.1136/bjophthalmol-2025-egsguidelines on 8 September 2025. Downloaded from http://bjo.bmj.com/ on September 29, 2025 by guest. Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

raised IOP, were enrolled. One eye of each participant was randomly assigned to receive LPI with the fellow eye left untreated. The primary outcome was incident PAC disease, as a composite of three endpoints, including PAS or IOP over 24 mmHg or AAC.[1]

Summary of the results:[2-6]

- Overall, there was a difference between treatment groups but the frequency of patients reaching the primary outcome was very low.
- At 6 years, primary outcome event occurred in 19 treated eyes (4.19 per 1000 eye- years) and 36 untreated eyes (7.97 per 1000 eye-years) (p=0.0041).
- At 14-years extended follow up, a primary endpoint occurred in 33 LPI-treated eyes (4.27 per 1000 eye-years) and 105 control eyes (13.59 per 1000 eye-years) (p<0.001).
- LPI was associated with 47% and 69% reduction of relative risk of PAC or AAC after 6 years (HR 0.53) and 14 years (HR 0.31), respectively.
- One of the LPI-treated eyes developed an acute attack of angle closure whereas 5 did so in control eyes.
- In untreated eyes the risk of PAC occurrence was associated with higher IOP, shallower limbal anterior chamber depth, smaller central anterior chamber depth and narrower angle width measured by Anterior Segment OCT.
- It is uncertain whether the findings of this trial are generalisable to non-Chinese populations. In addition, patients recruited in ZAP-trial were asymptomatic, did not have cataracts and had on average deeper anterior chambers depth, compared with patients treated with LPI in clinics.
- The authors suggested that prophylactic LPI should not be performed routinely in PACS. LPI is advisable only in high-risk eyes. In general PACS patients encountered at tertiary referral centres may represent more advanced cases with respect to ocular biometrics parameters and may be at higher risk compared to ZAP trial participants.

References:

1. He M, Jiang Y, Huang S, Chang DS, Munoz B, Aung T, Foster PJ, Friedman DS. Laser peripheral iridotomy for the prevention of angle closure: a single-centre, randomised controlled trial. Lancet 2019 Apr 20;393(10181):1609-18.
2. Jiang Y, Friedman DS, He M, Huang S, Kong X, Foster PJ. Design and methodology of a randomised controlled trial of laser iridotomy for the prevention of angle closure in southern China: the Zhongshan angle Closure Prevention trial. Ophthalmic Epidemiol 2010 Oct;17(5):321-32.
3. Congdon N, Yan X, Friedman DS, Foster PJ, van den Berg TJ, Peng M, Gangwani R,He M. Visual symptoms and retinal straylight after laser peripheral iridotomy: the Zhongshan Angle Closure Prevention Trial. Ophthalmology 2012 Jul;119(7):1375-82.
4. Jiang Y, Chang DS, Zhu H, Khawaja AP, Aung T, Huang S, Chen Q, Munoz B, Grossi CM, He M, Friedman DS, Foster PJ. Longitudinal changes of angle configuration in primary angle closure suspects: the Zhongshan Angle Closure Prevention Trial. Ophthalmology 2014 Sep;121(9):1699-1705.
5. Xu BY, Friedman DS, Foster PJ, Jiang Y, Porporato N, Pardeshi AA, Jiang Y, Munoz B, Aung T, He M. Ocular Biometric Risk Factors for Progression of Primary Angle Closure Disease: The Zhongshan Angle Closure Prevention Trial. Ophthalmology. 2022 March ;129(3):267–75.
6. Yuan Y, Wang W, Xiong R, Zhang J, Li C, Yang S, Friedman DS, Foster PJ, He M. Fourteen- Year Outcome of Angle-Closure Prevention with Laser Iridotomy in the Zhongshan Angle- Closure Prevention Study: Extended Follow-up of a Randomised Controlled Trial. Ophthalmology 2023 Aug;130(8):786-794.

The Guidelines project was entirely supported by the European Glaucoma Society Foundation

Br J Ophthalmol: first published as 10.1136/bjophthalmol-2025-egsguidelines on 8 September 2025. Downloaded from http://bjo.bmj.com/ on September 29, 2025 by guest. Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

7. Filippopoulos et al 2023. Ophthalmol Glaucoma. 2023 Nov-Dec;6(6):657-667. doi: 10.1016/j.ogla.2023.06.004. Epub 2023 Jun 13.

I.7.2.2 The Singapore asymptomatic narrow angles laser iridotomy study (ANA-LIS)

The ANA-LIS Study was an open-label, paired-eye, randomised controlled trial investigating prophylactic LPI versus no treatment in PACS. 480 participants (mostly women and Chinese) with bilateral PACS, defined as irido-trabecular contact of at least 180 degrees without PAS or raised IOP, were randomised to receive LPI in one eye and no treatment in the fellow eye. The primary outcome was the development of PAC or PACG. The follow up was 5 years.
Summary of results:[1-2]

- A significantly lower number of LPI-treated eyes reached one of the primary end points (5% with an incidence rate of 4.19 per 1000 eye-years) than control eyes (9% with an incidence rate of 21.84 per 1000 eye-years p= 0.001).
- Most of the difference between groups was attributable to PAS developing. No differences were seen in IOP and in the development of PACG.
- Older age and higher IOP after dilatation were associated with an increased risk of an end point developing.
- The overall progression rate from PACS to PAC or POAG was low, and the authors suggested that observation without LPI is a reasonable option for PACS.
- A later paper which applied a Markov model to ANA-LIS and ZAP trial data, showed that prophylactic LPI for PACS is cost-effective across a broad spectrum of ages and may even be cost-saving for younger patients.

References:

1. Baskaran M, Kumar RS, Friedman DS, Lu QS, Wong HT, Chew PTK, Lavanya R, Narayanaswamy A, Perera SA, Foster PJ, Aung T. the Singapore Asyntomatic Narrow Angles Laser Iridotomy Study. Five-Year Results of a Randomised Controlled Trial. Ophthalmology 2022;129:147-58.
2. Rothman AL, Gibbons A. Cost-Utility Analysis of Prophylactiuc Laser Peripheral Iridotomy for Primary Angle Closure Suspects. Am J Ophthalmol 2024;265:88-96.

I.7.3 Studies comparing treatment in open angle glaucoma

I.7.3.1 Advanced Glaucoma Intervention Study (AGIS)

AGIS was a multicentre, prospective randomised study in patients with OAG who could not be controlled by maximally-tolerated medical therapy alone. 591 patients (789 eyes) were randomised between two sequences of treatments.

1. ATT: argon laser trabeculectomy (ALT), followed by trabeculectomy, followed by a second trabeculectomy, or
2. TAT: trabeculectomy, followed by ALT, followed by a second trabeculectomy.

The surgical technique for performing trabeculectomies changed during the study period.

The Guidelines project was entirely supported by the European Glaucoma Society Foundation

Br J Ophthalmol: first published as 10.1136/bjophthalmol-2025-egsguidelines on 8 September 2025. Downloaded from http://bjo.bmj.com/ on September 29, 2025 by guest.
Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

Prior to 1990, antimetabolites were not used during surgery. After 1990, 5-Fluorouracil was used postoperatively. After 1991, mitomycin-C was used intraoperatively. Enrolled eyes had consistent elevation of IOP of ≥ 18 mmHg. Patients with MD worse than -16 dB were excluded, thus excluding eyes with very advanced glaucoma. About 1/3 of patients had early glaucoma. The main outcomes of interest were decreased VF or visual acuity.[1]

Summary of results:[2-9]

- After 7 years, mean reduction of IOP was greater for eyes assigned to the TAT protocol, and the cumulative probability of failure of the first intervention was greater for eyes assigned to the ATT protocol.
- The percentage of eyes with decreased visual acuity or VF progression was lower for the ATT sequence than for TAT in African American patients. Initial trabeculectomy slowed the progression of glaucoma more effectively in patients with white European ancestry.
- The probability of cataract formation after 5 years was high after trabeculectomy, 78%.
- Risk factors associated with progression were older age, longer follow-up, and increasing number of glaucoma interventions.
- IOP fluctuations were a risk factor for VF progression only in patients with mean IOP at low teens.
- Both ALT and trabeculectomy failed more often in younger patients and in eyes with higher pre-treatment IOP.
- In a post-hoc analysis of patients with 6-years of follow-up or more, eyes with an average IOP>17.5 mmHg over the first three 6-months visits showed more frequent VF deterioration compared to eyes with an average IOP<14 mmHg.
- Eyes with IOP<18 mmHg at 100% of the visits experienced no mean MD progression, whereas eyes with less stringent IOP control demonstrated VF progression.

References:

1. Brown RH, Lynch M, Leef D, et al. The Advanced Glaucoma Intervention Study (AGIS).1. Study Design and Methods and Base-Line Characteristics of Study Patients. Controlled Clinical Trials 1994;15(4):299-325.
2. Ederer F, Gaasterland DA, Dally LG, et al. The Advanced Glaucoma Intervention Study (AGIS): 13. Comparison of treatment outcomes within race: 10-year results. Ophthalmology 2004;111(4):651-64.
3. The Advanced Glaucoma Intervention Study (AGIS) investigators: 6. effect of cataract on visual field and visual acuity. Arch Ophthalmol 2000;118(12):1639-52.
4. The Advanced Glaucoma Intervention Study (AGIS) investigators: 9. Comparison of glaucoma outcomes in black and white patients within treatment groups. Am J Ophthalmol 2001;132(3):311-20.
5. The Advanced Glaucoma Intervention Study (AGIS) investigators: 8. Risk of cataract formation after trabeculectomy. Arch Ophthalmol 2001;119:1771-79.
6. Nouri-Mahdavi K, Hoffman D, Coleman AL, et al. Predictive factors for glaucomatous visual field progression in the Advanced Glaucoma Intervention Study. Ophthalmology 2004;111(9):1627-35.
7. Caprioli J, Coleman AL. Intraocular pressure fluctuation a risk factor for visual field progression at low intraocular pressures in the advanced glaucoma intervention study. Ophthalmology 2008;115(7):1123-9 e3.

The Guidelines project was entirely supported by the European Glaucoma Society Foundation

Br J Ophthalmol: first published as 10.1136/bjophthalmol-2025-egsguidelines on 8 September 2025. Downloaded from http://bjo.bmj.com/ on September 29, 2025 by guest. Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

8. The Advanced Glaucoma Intervention Study (AGIS) investigators: 11. Risk factors for failure of trabeculectomy and argon laser trabeculoplasty. Am J Ophthalmol 2002;134(4):481-98.
9. The Advanced Glaucoma Intervention Study (AGIS) investigators: 7. The relationship between control of intraocular pressure and visual field deterioration. Am J Ophthalmol 2000;130(4):429-40.

I.7.3.2 Collaborative Initial Glaucoma Treatment Study (CIGTS)

The CIGTS was a multicentre randomised controlled trial aimed at finding out if newly diagnosed OAG is better treated by initial treatment with medications or by immediate filtration surgery.1 A total of 607 patients with newly diagnosed OAG were randomised to initial treatment with either medication or trabeculectomy (with or without 5-fluorouracil). A target IOP algorithm was used tailored for each individual eye. Primary outcome variables were VF progression and QoL. Secondary outcome variables were visual acuity, IOP, and cataract formation. Inclusion criteria may have allowed recruitment of some patients with OHT, resulting in a case mix with a smaller risk of showing progression, patients with severe OAG were excluded.[1]

Summary of results:[2-10]

- IOP reduction was larger with surgery (48%; mean post treatment IOP 14-15 mmHg) than with medications (35%; mean post treatment IOP 17-18 mmHg).
- In the first few years, mean perimetric progression among all subjects was small and similar in both groups. After 8 years, 21% of surgical patients and 25% of medical patients had progressed, defined as a worsening of MD by 3 dBs.
- After adjustment for baseline risk factors, larger IOP variation measures were associated with significantly worse MD values after 3 to 9 years in the medication arm but not in the surgically treated group.
- QoL was initially better in the medically treated group but there was no difference in QoL at the last follow-up. Worry about becoming blind was reported by 50% of CIGTS participants at baseline but decreased in both treatment groups to 25% and remained constant thereafter.
- Patients randomised to the surgery arm underwent cataract surgery more than twice as often as patients in the medical treatment group.
- Reversal of optic disc cupping was seen in 13% in the surgical group but was not associated with improved visual function.
- 1.1% of surgical patients had developed endophthalmitis after 5 years.
- Risk factors for progression included higher baseline IOP, worse baseline VF status, and lower level of education.
- Risk factors for progression differed by treatment group. Patients with more advanced VF loss at baseline had less risk of progression when they received initial surgery versus medication but VF progression among participants with diabetes who received surgery was greater than those receiving medication. Greater VF progression was observed among medication arm participants who reported poorer adherence to medications.

References:

1. Musch DC, Lichter PR, Guire KE, Standardi CL. The Collaborative Initial Glaucoma Treatment Study: study design, methods, and baseline characteristics of enrolled patients. Ophthalmology 1999;106(4):653-62.

The Guidelines project was entirely supported by the European Glaucoma Society Foundation

Br J Ophthalmol: first published as 10.1136/bjophthalmol-2025-egsguidelines on 8 September 2025. Downloaded from http://bjo.bmj.com/ on September 29, 2025 by guest.
Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

2. Lichter PR, Musch DC, Gillespie BW, et al. Interim clinical outcomes in the Collaborative Initial Glaucoma Treatment Study comparing initial treatment randomised to medications or surgery. Ophthalmology 2001;108(11):1943-53.
3. Musch DC, Gillespie BW, Niziol LM, et al. Cataract extraction in the collaborative initial glaucoma treatment study: incidence, risk factors, and the effect of cataract progression and extraction on clinical and quality-of-life outcomes. Arch Ophthalmol 2006;124(12):1694-1700.
4. Musch DC, Gillespie BW, Niziol LM, et al. Factors associated with intraocular pressure before and during 9 years of treatment in the Collaborative Initial Glaucoma Treatment Study. Ophthalmology 2008;115(6):927-33.
5. Musch DC, Gillespie BW, Lichter PR, et al. Visual field progression in the Collaborative Initial Glaucoma Treatment Study the impact of treatment and other baseline factors. Ophthalmology 2009;116(2):200-07.
6. Musch DC, Gillespie BW, Niziol LM, et al. Intraocular pressure control and long-term visual field loss in the Collaborative Initial Glaucoma Treatment Study. Ophthalmology 2011;118(9):1766-73.
7. Janz NK, Wren PA, Lichter PR, et al. The Collaborative Initial Glaucoma Treatment Study: interim quality of life findings after initial medical or surgical treatment of glaucoma. Ophthalmology 2001;108(11):1954-65.
8. Zahid S, Musch DC, Niziol LM, Lichter PR. Risk of endophthalmitis and other long-term complications of trabeculectomy in the Collaborative Initial Glaucoma Treatment Study (CIGTS). Am J Ophthalmol 2013;155(4):674-80, 80.e1.
9. Parrish RK, Feuer WJ, Schiffman JC, Lichter PR, Musch DC & CIGTS Optic Disc Study Group. Five-year follow-up optic disc findings of the Collaborative Initial Glaucoma Treatment Study. Am J Ophthalmol 2009;147(4):717-24.e1.
10. Newman-Casey PA, Niziol LM, Gillespie BW, Janz NK, Lichter PR, Musch DC. The association between medication adherence and visual field progression in the Collaborative Initial Glaucoma Treatment Study. Ophthalmology 2020;127(4):477-483.

I.7.3.3 Low-Pressure Glaucoma Treatment Study (LoGTS)

The Low-Pressure Glaucoma Treatment Study (LoGTS) was a randomised, multicentre, double-masked trial comparing visual field (VF) stability in low-pressure glaucoma patients treated with twice-daily brimonidine tartrate 0.2% vs. timolol maleate 0.5%.

Eligible patients were ≥30 years old with untreated IOP ≤21 mmHg and no advanced VF loss or medication contraindications. Both eyes were randomised to monotherapy. Follow-up included Humphrey 24-2 perimetry, tonometry every 4 months, and annual optic disc photos.

Main outcome measure was VF progression in either eye, defined by ≥3 points with a negative slope ≥-1 dB/year at p<5% on 3 consecutive tests (pointwise linear regression). Secondary outcome measures were progression based on glaucoma change probability maps (GCPM) of pattern deviation and the 3-omitting method for pointwise linear regression.

A total of 99 patients received brimonidine and 79 received timolol. Mean follow-up was 30.0 ± 2 months. Of 190 enrolled, 12 (6.3%) were excluded post-randomization and 77 (40.5%) did not complete 4 years.[1]

The Guidelines project was entirely supported by the European Glaucoma Society Foundation

Br J Ophthalmol: first published as 10.1136/bjophthalmol-2025-egsguidelines on 8 September 2025. Downloaded from http://bjo.bmj.com/ on September 29, 2025 by guest. Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

Summary of the results:

- Statistically fewer brimonidine-treated patients (9.1%) had visual field progression by pointwise linear regression than timolol-treated patients (39.2%, p=0.001).
- Eyes randomised to timolol progressed faster (mean rates of progression, -0.38 ± 0.9 vs 0.02 ± 0.7 dB/y, p <0 .01).
- Older age (HR = 1.41/decade older, p = .022), use of systemic antihypertensives HR = 2.53, p = .005), and mean ocular perfusion pressure (HR = 1.21/mm Hg lower, p < .001) were associated with progression whereas randomization to brimonidine revealed a protective effect (HR = 0.26,, p < .001).
- Mean treated IOP was similar across groups at all time points.
- Mean deviation and corrected pattern standard deviation from the visual fields were not correlated with Imean, peak, trough, or peak minus trough IOPs.
- In unilateral VF loss cases (n = 53, there were no differences in any IOP parameter between eyes.
- More brimonidine patients discontinued due to adverse events (28.3% vs. 11.4%, p = 0.008).
- Due to the lack of data from the 12 excluded participants and the 77 who did not complete follow-up, no definitive conclusions can be made regarding potential IOP-independent effects of brimonidine.

References:

1. Krupin T, Liebmann JM, Greenfield DS, Rosenberg LF, Ritch R, Yang JW; Low-Pressure Glaucoma Study Group. The Low-pressure Glaucoma Treatment Study (LoGTS) study design and baseline characteristics of enrolled patients. Ophthalmology. 2005 Mar;112(3):376-85.
2. Greenfield DS, Liebmann JM, Ritch R, Krupin T; Low-Pressure Glaucoma Study Group. Visual field and intraocular pressure asymmetry in the low-pressure glaucoma treatment study. Ophthalmology. 2007 Mar;114(3):460-5.
3. Krupin T, Liebmann JM, Greenfield DS, Ritch R, Gardiner S; Low-Pressure Glaucoma Study Group. A randomised trial of brimonidine versus timolol in preserving visual function: results from the Low-Pressure Glaucoma Treatment Study. Am J Ophthalmol. 2011 Apr;151(4):671-81. doi: 10.1016/j.ajo.2010.09.026. Epub 2011 Jan 22. Erratum in: Am J Ophthalmol. 2011 Jun;151(6):1108. PMID: 21257146.
4. De Moraes CG, Liebmann JM, Greenfield DS, Gardiner SK, Ritch R, Krupin T; Low-pressure Glaucoma Treatment Study Group. Risk factors for visual field progression in the low-pressure glaucoma treatment study. Am J Ophthalmol. 2012 Oct;154(4):702-11.
5. Sena DF, Lindsley K. Neuroprotection for treatment of glaucoma in adults. Cochrane Database Syst Rev. 2013 Feb 28;2(2):CD006539. doi: 10.1002/14651858.CD006539.pub3. Update in: Cochrane Database Syst Rev. 2017 Jan 25;1:CD006539. doi: 10.1002/14651858. CD006539.pub4. PMID: 23450569; PMCID: PMC4261923.

I.7.3.4 The Tube versus Trabeculectomy Study (TVT)

The TVT Study enrolled 212 eyes from 212 patients at 17 centres—107 in the tube group and 105 in the trabeculectomy group. The mean age was 71 years, and 53% were female. Baseline intraocular pressure (IOP) was 25.3 ± 5.3 mm Hg, with 81% diagnosed with primary open-angle glaucoma.

The Guidelines project was entirely supported by the European Glaucoma Society Foundation

Br J Ophthalmol: first published as 10.1136/bjophthalmol-2025-egsguidelines on 8 September 2025. Downloaded from http://bjo.bmj.com/ on September 29, 2025 by guest. Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

Eligible participants were aged 18–85 with prior trabeculectomy and/or cataract extraction with intraocular lens implantation, and uncontrolled glaucoma (IOP 18–40 mm Hg) on maximally tolerated medical therapy. Qualifying prior surgeries included cataract extraction (44%), trabeculectomy (35%), and combined procedures (20%).

Patients were randomised to receive either a 350 mm^2 Baerveldt glaucoma implant or trabeculectomy with mitomycin C (0.4 mg/mL for 4 minutes). Scheduled follow-ups occurred at 1 day, 1 week, 1, 3, 6, and 12 months, then annually through 5 years. Failure was defined prospectively as IOP >21 mm Hg or <20% reduction from baseline on two consecutive visits after 3 months, IOP ≤5 mm Hg on two visits after 3 months, reoperation for glaucoma, or loss of light perception.

Summary of results:[2-9]

- Mean IOP was significantly lower in the trabeculectomy group during the first 3 months, but no sustained differences were observed thereafter.
- The tube group required more medications during the first 2 years. Over time, medication use increased in the trabeculectomy group, equalizing between groups by year 3.
- At 5 years, cumulative failure rates were 29.8% (tube) and 46.9% (trabeculectomy) (p = 0.002; HR 2.15; 95% CI: 1.30–3.56).
- Post hoc analyses using stricter IOP thresholds showed higher failure in the trabeculectomy group:
  - ≤17 mm Hg: 31.8% (tube) vs. 53.6% (trabeculectomy) (p = 0.002; HR 2.04)
  - ≤14 mm Hg: 52.3% vs. 71.5%, respectively (p = 0.017; HR 1.57)
- Postoperative complications were more frequent in the trabeculectomy group (63% vs. 43%, p = 0.006), though most were transient. The incidence of serious complications (requiring reoperation or causing ≥2-line Snellen VA loss) was similar between groups (22% tube vs. 20% trabeculectomy, p = 0.79).

References:

1. Gedde SJ, Schiffman JC, Feuer WJ, et al. The Tube Versus Trabeculectomy Study: Design and baseline characteristics of study patients. Am J Ophthalmol. 2005;140:275–287.
2. Gedde SJ, Schiffman JC, Feuer WJ, et al. Treatment outcomes in the Tube Versus Trabeculectomy Study after one year of follow-up. Am J Ophthalmol. 2007;143:9–22.
3. Gedde SJ, Schiffman JC, Feuer WJ, et al. Treatment outcomes in the Tube Versus Trabeculectomy Study after five years of follow-up. Am J Ophthalmol. 2012;153:789–803.
4. Gedde SJ, Herndon LW, Brandt JD, et al. Postoperative complications in the Tube Versus Trabeculectomy Study (TVT) during five years of follow-up. Am J Ophthalmol. 2012;153:804–814.
5. Chen PP, Yamamoto T, Sawada A, et al. Use of antifibrosis agents and glaucoma drainage devices in the American and Japanese Glaucoma Societies. J Glaucoma. 1997;6:192–196.
6. Joshi AB, Parrish RK, Feuer WF. 2002 Survey of the American Glaucoma Society. Practice preferences for glaucoma surgery and antifibrotic use. J Glaucoma. 2005;14:172–174.
7. Desai MA, Gedde SJ, Feuer WJ, et al. Practice preferences for glaucoma surgery: A survey of the American Glaucoma Society in 2008. Ophthalmic Surg Lasers Imaging. 2011;42:202–208.
8. Ramulu PY, Corcoran KJ, Corcoran SL, Robin AL. Utilization of various glaucoma surgeries and procedures in Medicare beneficiaries from 1995 to 2004. Ophthalmology. 2007;114:2265–2270.

The Guidelines project was entirely supported by the European Glaucoma Society Foundation

Br J Ophthalmol: first published as 10.1136/bjophthalmol-2025-egsguidelines on 8 September 2025. Downloaded from http://bjo.bmj.com/ on September 29, 2025 by guest. Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

I.7.3.5 Treatment of Advanced Glaucoma Study (TAGS)

The TAGS was a pragmatic, multicentre, randomised controlled trial designed to evaluate the best primary therapeutic approach in advanced glaucoma. A total of 453 patients with newly diagnosed untreated severe OAG glaucoma (based on Hodapp- Parrish-Anderson classification) were Randomised 1:1 to initially receive one or more medication (primary medical treatment group) or MMC-augmented trabeculectomy (primary trabeculectomy group). Target IOP was individualized at baseline (based on Canadian Consensus on target IOP) and treatment could be escalated based on clinician's judgment. The primary outcome was health-related QoL measured by VFQ-25. Secondary outcomes include IOP, VF MD, visual acuity, need for cataract surgery, PROMs by EQ-5D-5L, HUI-3. GUI, adverse events and health economic outcomes. Follow up was 2 years with a planned extension to 5 year.[1-2]

Summary of results:[3-6]

- There were no differences for vision related QoL between groups. The mean ± SD VFQ-25 score in the medical treatment and trabeculectomy groups was 84.5 ± 16.3 and 85.4 ± 13.8, respectively at 2 years (p=0.38), 81.3 ± 17.5 and 83.3 ± 15.5 respectively at 5 years, (p=0.51).
- No difference between groups were found for PROM's as measured by EQ-5D-5L, HUI-3, and GUI.
- IOP was consistently lower in the trabeculectomy group at all time points.
- At 5 years IOP was 12.07 ± 5.18 mmHg in the trabeculectomy group and 14.76 ± 4.14 mmHg in the medical treatment group (p<0.001).
- At 5 years mean VF MD was better in the trabeculectomy group (-14.30 ± 7.14) than the medical group (-16.74 ± 6.78) (p<0.001)
- Visual acuity was worse in the trabeculectomy group at 2 years (mean difference 0.07; p=0.006) but no differences were found between groups at 5 years (mean difference 0.02; p=0.48). No unexplained loss of vision occurred immediately after surgery.
- Fewer participants in the trabeculectomy group were receiving eye drops (35.4% vs 72.5% at 5 years).
- Adverse events were similar between groups.
- 8% of the trabeculectomy group did require an intervention to manage clinically significant hypotony.
- Cost-effectiveness of trabeculectomy was worse at 24 months, but it has a higher probability of being cost effective over a patient's lifetime.
- The authors suggested that trabeculectomy can be offered as a primary intervention in advanced glaucoma.

References:

1. King AJ, Fernie G, Azuara-Blanco A, Burr JM, Garway-Heath DF, Sparrow JM, Vale L, Hudson J, MacLennan G, McDonald A, Barton K, Norrie J. Treatment of Advanced Glaucoma Study: a multicentre randomised controlled trial comparing primary medical treatment with primary trabeculectomy for people with newly diagnosed advanced glaucoma-study protocol. Br J Opthalmol. 2018 Jul;102(7):922-928.
2. King AJ, Hudson J, Fernie G, Burr J, Azuara-Blanco A, Sparrow JM, Barton K, Garway-Heath DF, Kernohan A, MacLennan G. Baseline Characteristics of Participants in the Treatment of Advanced Glaucoma Study: A Multicenter Randomised Controlled Trial. Am J Ophthalmol. 2020 May:213:186-94.

The Guidelines project was entirely supported by the European Glaucoma Society Foundation

Br J Ophthalmol: first published as 10.1136/bjophthalmol-2025-egsguidelines on 8 September 2025. Downloaded from http://bjo.bmj.com/ on September 29, 2025 by guest.
Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

3. King AJ, Hudson J, Fernie G, Kernohan A, Azuara-Blanco A, Burr J, Homer T, Shabaninejad H, Sparrow JM, Garway-Heath DF, Barton K, Norrie J, McDonald A, Vale L, MacLennan G. Primary trabeculectomy for advanced glaucoma: pragmatic multicentre randomised controlled trial (TAGS). BMJ. 2021 Jun 16:373:n1510.
4. King AJ, Fernie G, Hudson J, Kernohan A, Azuara-Blanco A, Burr J, Homer T, Shabaninejad H, Sparrow JM, Garway-Heath D, Barton K, Norrie J, McDonald A, Vale L, MacLennan G. Primary trabeculectomy versus primary glaucoma eye drops for newly diagnosed advanced glaucoma: TAGS RCT. Health Technol Assess. 2021 Nov;25(72):1-158.
5. Montesano G, Ometto G, King A, Garway-Heath DF, Crabb DP. Two-Year Visual Field Outcomes of the Treatment of Advanced Glaucoma Study (TAGS). Am J Ophthalmol. 2023 Feb:246:42-50.
6. King AJ, Hudson J, Azuara-Blanco A, Burr J, Kernohan A, Homer T, Shabaninejad H, Sparrow JM, Garway-Heath D, Barton K, Norrie J, Davidson T, Vale L, MacLennan G. Evaluating Primary Treatment for People with Advanced Glaucoma: Five-Year Results of the Treatment of Advanced Glaucoma Study. Ophthalmology 2024 Jul;131(7):759-70.
7. King AJ, Hudson J, Azuara-Blanco A, Kirwan JF, Goyal S, Lim KS, Maclennan G; TAGS research group. Effects of socioeconomic status on baseline values and outcomes at 24 months in the Treatment of Advanced Glaucoma Study randomised controlled Trial. Br J Ophthalmol. 2024 Jan 29;108(2):203-210.
8. Shabaninejad H, Homer T, Kernohan A, King AJ, Burr J, Azuara-Blanco A, Vale L. Is primary trabeculectomy cost-effective for patients with advanced primary open angle glaucoma? Results from the Treatment of Advanced Glaucoma Study economic model. Br J Ophthalmol. 2024 Aug 22;108(9):1210-1215.
9. Kernohan A, Homer T, Shabaninejad H, King AJ, Hudson J, Fernie G, Azuara-Blanco A, Burr J, Sparrow JM, Garway-Heath D, Barton K, Norrie J, Maclennan G, Vale L. Cost-effectiveness of primary surgical versus primary medical management in the treatment of patients presenting with advanced glaucoma. Br J Ophthalmol. 2022 Jul 26;107(10):1452–7.

I.7.3.6 Glaucoma Intensive Treatment Study (GITS)

The GITS was a prospective, double-center, parallel group, open-label, Randomised trial to compare the efficacy of initial monotherapy versus intensive initial multitherapy in preserving visual function and QoL, in POAG and PXFG.
A total of 298 eyes of 242 newly diagnosed, untreated patients were randomised to receive either single-drug eye drop (monotherapy group) or a multi-treatment approach including 3 drugs, followed by a 360° laser trabeculoplasty (SLT or ALT) a week later (multitherapy group). According to VF progression, IOP or side-effects, treatment could be escalated or changed as needed. The primary outcome was the final VF status as assessed by three different criteria: the predicted VFI at the end of expected lifetime; the rate of progression of VF damage; a definite VF progression based on EMGT progression event analysis. Patients with VFI<65% were excluded. Follow up was 5 years.
Summary of results:[1-3]
– The projected VFI at predicted end of life, was 79.3% in the mono-treatment group and 87.1% in the multi-treatment group (p= 0.15).

The Guidelines project was entirely supported by the European Glaucoma Society Foundation

Br J Ophthalmol: first published as 10.1136/bjophthalmol-2025-egsguidelines on 8 September 2025. Downloaded from http://bjo.bmj.com/ on September 29, 2025 by guest. Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

- The VFI median rate of progression was -0.66%/year in the monotherapy group and -0.25% in the multitherapy group, but this difference was not statistically significant (p=0.09).
- Subgroup analysis of patients with higher baseline IOP (>24 mmHg) showed that the rate of progression was 5.5 times faster in the monotherapy group (p=0.06).
- The number of participants reaching a definite VF progression event was higher in the monotherapy group (21% vs 11%) (p=0.03).
- The median IOP over the 5 years of follow-up were 17 and 14 mmHg in mono- and in multitreatment groups.
- Treatment was intensified in 49% of participants in the monotherapy group and in 12% of participants in the multitherapy group. 20 participants in the multitherapy group had treatment reduction. Six patients (5%) in the monotherapy group and 7 in the multitreatment group (6%) needed glaucoma surgery after treatment intensification.
- Adverse events occurred in 25% of participants Randomised to monotherapy and 36% of those Randomised to multitherapy (p=0.04)
- Authors concluded that initial intensive treatment may be considered in glaucoma patients with high untreated IOP at diagnosis. No evidence emerged about giving initial multitherapy routinely to all glaucoma patients.

References:

1. Bengtsson B, Heijl H, Johannesson G, Andersson-Geimer S, Aspberg J, Linden C.The Glaucoma Intensive Treatment Study (GITS), a Randomised clinical trial: design, methodology and baseline data. Acta Opthalmol. 2018 Sep;96(6):557-66.
2. Bengtsson B, Lindén C, Heijl H, Andersson-Geimer S, Aspberg J, Johannesson G. The Glaucoma Intensive Treatment Study: interim results from an ongoing longitudinal Randomised clinical trial. Acta Opthalmol. 2022 Mar;100(2):e455-e462.
3. Bengtsson B, Heijl H, Aspberg J, Johannesson G, Andersson-Geimer S, Linden C. The Glaucoma Intensive Treatment Study (GITS): A Randomised Controlled Trial Comparing Intensive and Standard Treatment on 5 Years Visual Field Development. AM J Ophthalmol. 2024 OCT:266:274-288.

I.7.3.7 Primary Tube versus Trabeculectomy Study (PTVT)

The PTVT Study was a multicentre, prospective, Randomised controlled trial comparing primary trabeculectomy with mitomycin-C (MMC) to tube shunt implantation (350 mm^2 Baerveldt implant) in eyes with no history of prior incisional ocular surgery. A total of 242 eyes from 242 patients were enrolled across 16 clinical centres.

Eligible patients were 18–85 years old with IOP between 18–40 mm Hg on maximum tolerated medical therapy. The mean age was 61.4 ± 11.8 years, 66% were male, and 90% had primary open-angle glaucoma. The baseline IOP was 23.6 ± 5.3 mm Hg, and the mean number of medications was 3.2 ± 1.1. Patients were Randomised to receive either a tube shunt (Baerveldt 350 mm^2) or trabeculectomy with MMC (0.4 mg/mL for 2 minutes). Follow-up visits occurred at 1 day, 1 week, 1 month, 3 months, 6 months, 1 year, and annually through 5 years. Failure was defined as IOP >21 mm Hg or <20% reduction from baseline on two consecutive visits after 3 months, IOP ≤5 mm Hg, reoperation for glaucoma, or loss of light perception. Complete success was defined as IOP control without medications, while qualified success allowed the use of medications.

The Guidelines project was entirely supported by the European Glaucoma Society Foundation

Br J Ophthalmol: first published as 10.1136/bjophthalmol-2025-egsguidelines on 8 September 2025. Downloaded from http://bjo.bmj.com/ on September 29, 2025 by guest. Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

Summary of the results:

- At 1 year, the cumulative probability of failure was higher in the tube group (20%) than the trabeculectomy group (8%) (p = 0.02). At 3 years, failure remained higher in the tube group (39% vs 30%, p = 0.17), and at 5 years, the failure rate was 42% in the tube group vs 35% in the trabeculectomy group (p = 0.21; HR = 1.31; 95% CI = 0.86–2.01).
- At 1 year, mean IOP was significantly lower in the trabeculectomy group (12.4 ± 4.4 mm Hg) than the tube group (13.8 ± 4.1 mm Hg, p = 0.01). This difference persisted at 3 years (12.1 ± 4.8 mm Hg vs 14.0 ± 4.2 mm Hg, p = 0.008), and at 5 years, IOP remained similar between groups (13.0 ± 5.2 mm Hg vs 13.4 ± 3.5 mm Hg, p = 0.52).
- Baseline medication use was similar between groups. At 3 years, patients in the trabeculectomy group used fewer medications (1.2 ± 1.5) than those in the tube group (2.1 ± 1.4, p < 0.001). This difference persisted at 5 years (1.3 ± 1.4 vs 2.2 ± 1.3, p < 0.001).
- At 1 year, complete success was more common in the trabeculectomy group (59% vs 14%, p < 0.001). At 3 years, complete success remained higher (44% vs 13%, p < 0.001). At 5 years, complete success was achieved in 34% of trabeculectomy patients vs 9% in the tube group. Qualified success at 5 years was 27% (trabeculectomy) vs 44% (tube).
- Early (<1 month) complications occurred more frequently in the trabeculectomy group (33% vs 20%, p = 0.03). Late complications at 3 years were similar between groups (25% vs 22%, p = 0.65).

References:

1. Gedde SJ, Chen PP, Heuer DK, Singh K, Wright MM, Feuer WJ, Schiffman JC, Shi W; Primary Tube Versus Trabeculectomy Study Group. The Primary Tube Versus Trabeculectomy Study: Methodology of a Multicenter Randomised Clinical Trial Comparing Tube Shunt Surgery and Trabeculectomy with Mitomycin C. Ophthalmology. 2018 May;125(5):774-781.
2. Gedde SJ, Feuer WJ, Shi W, Lim KS, Barton K, Goyal S, Ahmed IIK, Brandt J; Primary Tube Versus Trabeculectomy Study Group. Treatment Outcomes in the Primary Tube Versus Trabeculectomy Study after 1 Year of Follow-up. Ophthalmology. 2018 May;125(5):650-663.
3. Gedde SJ, Feuer WJ, Lim KS, Barton K, Goyal S, Ahmed IIK, Brandt JD; Primary Tube Versus Trabeculectomy Study Group. Treatment Outcomes in the Primary Tube Versus Trabeculectomy Study after 3 Years of Follow-up. Ophthalmology. 2020 Mar;127(3):333-345.
4. Gedde SJ, Feuer WJ, Lim KS, Barton K, Goyal S, Ahmed II, Brandt JD; Primary Tube Versus Trabeculectomy Study Group. Treatment Outcomes in the Primary Tube Versus Trabeculectomy Study after 5 Years of Follow-up. Ophthalmology. 2022 Dec;129(12):1344-1356.
5. Steven J. Gedde, William J. Feuer, Kin Sheng Lim, Keith Barton, Saurabh Goyal, Iqbal I. Ahmed, et al. Postoperative Complications in the Primary Tube Versus Trabeculectomy Study During 5 Years of Follow-up. Ophthalmology. 2022, 1357-1367.
6. Gedde SJ, Vinod K, Prum BE Jr; Primary Tube Versus Trabeculectomy Study Group. Results from the Primary Tube Versus Trabeculectomy Study and translation to clinical practice. Curr Opin Ophthalmol. 2023 Mar 1;34(2):129-137.

The Guidelines project was entirely supported by the European Glaucoma Society Foundation

Br J Ophthalmol: first published as 10.1136/bjophthalmol-2025-egsguidelines on 8 September 2025. Downloaded from http://bjo.bmj.com/ on September 29, 2025 by guest. Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

I.7.3.8 Laser in Glaucoma and Ocular Hypertension Trial (LiGHT)

The LiGHT was a multi-centre randomised controlled trial, comparing selective laser trabeculoplasty (SLT) versus eye-drops as first-line treatment for OHT or OAG.
A total of 718 newly diagnosed, untreated OHT or OAG patients were randomised to primary SLT, followed by topical medications as required (the SLT group), or topical medication (the drops group). Eyes in the SLT group, had up to two SLT treatments before drops if required. Target IOP, treatment escalation and monitoring intervals were individualized based on disease severity and pre-treatment IOP, and adjusted during the trial based on IOP control, disease stability and adverse reactions. The primary outcome was health-related QoL assessed with the EQ-5D. Secondary outcomes include glaucoma-specific be patients reported outcomes, clinical effectiveness, visual function and safety. Approximately 30% of study participants were OHT and 50% were early-stage OAG. Follow up was 3 years, extended to 6 years.[1]
Summary of results:[2-5]

- There were no differences in health-related QoL for the EQ-5D between the two groups.
- 74.2% and 69.8% of the SLT group remained within target IOP without medication at 3 and 6 years of follow up, respectively.
- Eyes in the SLT group required fewer trabeculectomies (nil vs 11) and suffered less disease progression than patients in the drops group (3.8% vs 5.8%) at 3 years. However, according to the study protocol patients in the SLT group were receiving medications in case more IOP lowering was needed, while patients in the drops group were not offered SLT but only trabeculectomy when more IOP lowering was needed.
- After 6 years eyes in the SLT group underwent less trabeculectomy (2.4% vs 5.8%) ($p<0.001$) and less phacoemulsification (10.4 vs 17.3) ($p=0.03$), than eyes in the drops group.
- At 6 years, 107 eyes (19.6%) in the SLT group showed disease progression compared with 147 eyes (26.8%) in the drops group ($p=0.01$).
- A further analysis of total deviation of VF, confirmed that eyes initially treated with SLT showed slower VF progression than eyes with initial medical therapy.
- SLT was safe and cost-effective compared with medications.
- The authors suggested that SLT could be routinely offered as first line treatment to all newly diagnosed patients with OHT or POAG. It is uncertain whether the findings of this trial are generalizable to all stages of POAG, since the vast majority of study participants were either ocular hypertensives or had early stage damage.

References:

1. Konstantakopoulou E, Gazzard G, Vickerstaff V, Jiang Y, Nathwani N, Hunter R, Ambler G, Bunce C; LiGHT Trial Study Group. The Laser in Glaucoma and Ocular Hypertension (LiGHT) trial. A multicentre randomised controlled trial: baseline patient characteristics. Br J Ophthalmol. 2018 May;102(5):599-603.
2. Gazzard G, Konstantakopoulou E, Garway-Heath D, Garg A, Vickerstaff V, Hunter R, Ambler G, Bunce C, Wormald R, Nathwani N, Barton K, Rubin G, Buszewicz M; LiGHT Trial Study Group. Selective laser trabeculoplasty versus eye drops for first-line treatment of ocular hypertension and glaucoma (LiGHT): a multicentre randomised controlled trial. Lancet 2019 Apr 13;393(10180):1505-16.
3. Gazzard G, Konstantakopoulou E, Garway-Heath D, Garg A, Vickerstaff V, Hunter R, Ambler G, Bunce C, Wormald R, Nathwani N, Barton K, Rubin G, Morris S, Buszewicz M. Selective laser trabeculoplasty versus drops for newly diagnosed ocular hypertension and glaucoma: the LiGHT RCT. Health Technol Assess 2019 Jun;23(31):1-102.

The Guidelines project was entirely supported by the European Glaucoma Society Foundation

Br J Ophthalmol: first published as 10.1136/bjophthalmol-2025-egsguidelines on 8 September 2025. Downloaded from http://bjo.bmj.com/ on September 29, 2025 by guest.
Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

4. Gazzard G, Konstantakopoulou E, Garway-Heath D, Garg A, Vickerstaff V, Hunter R, Ambler G, Bunce C, Wormald R, Nathwani N, Barton K, Rubin G, Morris S, Buszewicz M. Selective laser trabeculoplasty versus drops for newly diagnosed ocular hypertension and glaucoma: the LiGHT RCT. Health Technol Assess 2019;23:1-102.
5. Wright DM, Konstantakopoulou E, Montesano G, Nathwani N, Garg A, Garway-Heath D, Crabb DP, PhD, Gazzard G, on behalf of the Laser in Glaucoma and Ocular Hypertension Trial (LiGHT) Study Group. Visual Field Outcomes from the Multicenter, Randomised Controlled Laser in Glaucoma and Ocular Hypertension Trial (LiGHT). Ophthalmology 2020;127:1313-21.
6. Gazzard G, Konstantakopoulou E, Garway-Heath D, Adeleke M, Vickerstaff V, Ambler G, Hunter R, Bunce C, Nathwani N, Barton K, The LiGHT trial group. Laser in Glaucoma and Ocular Hypertension (LiGHT) Trial. Six-Year Results of Primary Selective Laser Trabeculoplasty versus Eye Drops for the Treatment of Glaucoma and Ocular Hypertension. Ophthalmology 2023;130:139-51.

I.7.4 Studies comparing treatment in angle closure

I.7.4.1 Effectiveness in Angle-closure Glaucoma of Lens Extraction Study (EAGLE)

The EAGLE study was a multicentre, randomised, prospective clinical trial designed to compare clear-lens extraction (CLE) vs LPI plus topical medical therapy as first line treatment in PAC or PACG. Eligible patients were aged 50 years or older, did not have cataracts, and had newly diagnosed PAC, with IOP 30 mmHg or greater, or PACG. A total of 419 patients were randomised to lens extraction (208, CLE group) or LPI (211, LPI group). Clinicians were allowed to escalate treatment to achieve target IOP. Primary outcome measures included QoL, assessed with the European Quality of Life-5 Dimensions (EQ-5D), IOP, and cost-effectiveness, assessed at 3 years.[1]

Summary of results:[2-5]

- At 3 years, results show advantage of primary CLE over LPI for QoL and IOP.
- Mean health status score on the EQ-5D (range 0; 1) after lens extraction was 0.052 higher than after LPI.
- Mean IOP was 1.18 mm Hg lower after lens extraction than after LPI.
- Significantly fewer participants in the CLE group needed medications (21% vs 61% with at least one drop) or glaucoma surgery (1 vs 24 operations) to control IOP.
- Patients in the CLE group were 5 times more likely to have better long-term IOP control and 10 times more likely to be free of drops or surgery.
- The incremental cost-effectiveness ratio was better for initial CLE versus LPI (calculated on a subset of patients treated in the UK; not conclusive for other settings).
- VF severity at 3 years remained similar in the two treatment groups.
- This study supports the use of initial lens extraction as a first-line intervention for PAC with high IOP (≥ 30mmHg) or PACG, and in patients over 50 years of age. The study results are not generalisable to all PAC or PACG cases.
- To note, in this trial the participating surgeons were experienced. Lens extraction to treat angle closure can be technically challenging.

The Guidelines project was entirely supported by the European Glaucoma Society Foundation

Br J Ophthalmol: first published as 10.1136/bjophthalmol-2025-egsguidelines on 8 September 2025. Downloaded from http://bjo.bmj.com/ on September 29, 2025 by guest. Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

References:

1. Azuara-Blanco A, Burr J, Ramsay C, et al. Effectiveness of early lens extraction for the treatment of primary angle closure glaucoma (EAGLE): a randomised controlled trial. The Lancet 2016;388:1389-97.
2. Traverso CE. Clear-lens extraction as a treatment for primary angle closure. The Lancet 2016;388:1352-54.
3. Javanbakht M, Azuara-Blanco A, Burr JM, Ramsay C, Cooper D, Cochran C, Norrie J, Scotland G. Early lens extraction with intraocular lens implantation for the treatment of primary angle closure glaucoma: an economic evaluation based on data from the EAGLE trial. BMJ Open. 2017.13;7:e013254.
4. Day AC, Cooper D, Burr J, et al. Clear lens extraction for the management of primary angle closure glaucoma: surgical technique and refractive outcomes in the EAGLE cohort. Br J Ophthalmol 2018;102(12):1658-62.
5. Mitchell WG, Azuara-Blanco A, Foster PJ, Halawa O, Burr J, Ramsay CR, Cooper D, Cochran C, Norrie J, Friedman D, Chang D. Predictors of long-term intraocular pressure control after lens extraction in primary angle closure glaucoma: results from the EAGLE trial. Br J Ophthalmol 2023 Aug;107(8):1072-1078.

Landmark clinical trials are studies considered as highly informative for patient management that clarified previously unclear answers to critical questions thus shaping paient care.

Randomised Controlled Trials (RCTs) are the highest level of evidence-based medicine and are pivotal for guiding clinical practice; however, results of a single RCT must be applied only to the same context of the study (i.e. clinical pathway, population enrolled, treatment options). Results of a RCT should be generalized with caution to patients different from those included in the trial.

The Guidelines project was entirely supported by the European Glaucoma Society Foundation

Br J Ophthalmol: first published as 10.1136/bjophthalmol-2025-egsguidelines on 8 September 2025. Downloaded from http://bjo.bmj.com/ on September 29, 2025 by guest.
Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

I.8 Cost-effectiveness of glaucoma care and glaucoma screening

I.8.1 Cost-effectiveness of glaucoma care

Cost-effectiveness is an important consideration when choosing diagnostic, monitoring and treatment interventions as well as when designing and evaluating glaucoma care pathways. Going forward, we need glaucoma studies to include measures of cost- effectiveness in their outcomes.

I.8.2 Screening for glaucoma

Screening for glaucoma has traditionally relied on case finding using costly and time- consuming diagnostic tools, which has made population-wide screening economically unviable and therefore not recommended to date. However, emerging technologies— such as artificial intelligence and genetic risk profiling through polygenic risk scores—hold promise to improve efficiency and reduce costs, potentially tipping the balance toward cost-effectiveness. While earlier economic models have yielded mixed conclusions, further research is needed to quantify the real-world benefits of population screening, particularly in preventing visual field loss, optic nerve damage, or declines in patient- reported outcomes.

I.8.3 Clinical and cost-effectiveness of diagnostic tests used for screening, detection and monitoring for glaucoma

Although there are numerous comparative diagnostic studies, there is no evidence regarding which combination of tests, or which testing frequency improve patient outcomes at a sustainable cost. Nevertheless, data from the UK suggests that a combination of structural tests may be cost-effective in triaging at-risk patients. Short follow-up intervals of less than 1 year for ocular hypertension or stable glaucoma are unlikely to be cost-effective.
There is a high degree of variability in the design and quality of diagnostic accuracy studies for glaucoma. When evaluating cost-effectiveness, it should be noted that care protocols and costs for patients and health systems vary hugely between different national and regional health systems. The cost of blindness should also be taken into consideration.

I.8.4 Cost-effectiveness of treatment of glaucoma and ocular hypertension preventing visual disability

Although direct evidence on the cost-effectiveness of glaucoma treatment is limited, hypotensive therapy remains a clinically justified approach due to its proven ability to slow disease progression and prevent vision loss.

The Guidelines project was entirely supported by the European Glaucoma Society Foundation

Br J Ophthalmol: first published as 10.1136/bjophthalmol-2025-egsguidelines on 8 September 2025. Downloaded from http://bjo.bmj.com/ on September 29, 2025 by guest.
Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

Treatment of all OHT patients does not appear to be cost-effective. However, treatment of selected OHT patients with risk factors such as advanced age and higher pressures may be cost-effective in preventing conversion to glaucoma. On the other hand, it is not cost-effective to treat low-risk OHT individuals.
In glaucoma and OHT, evidence favors laser trabeculoplasty as the first-line treatment for glaucoma, because it may work better than topical medication in slowing down the VF progression at a lower cost compared to medications in some settings.
In advanced glaucoma, early trabeculectomy may be cost-effective when modelled over the patients' life-time.
There are insufficient non-sponsored trials on MIGS to adequately evaluate the cost effectiveness of such procedures.

I.8.5 Cost-effectiveness research and glaucoma

So far, cost-effectiveness evaluation of glaucoma care pathways has been relatively unstructured, resulting in unclear and conflicting implications for clinical management. Future cost-effectiveness studies should include structured glaucoma-specific real- world data using electronic health records, also combining functional and structural measures. In addition, they should consider patients' and clinicians' perspectives, potential commercial bias, analysis of long-term outcomes, including direct and indirect costs and QoL measures, as well as tools to evaluate care pathway innovations and benchmark outcomes.

- While screening for OAG has not been shown to be cost-effective in the general population within high-resource settings, it may be cost-effective when targeted toward high-risk groups.
- Treatment of ocular hypertension is cost-effective only among OHT individuals with additional risk factors.
- In glaucoma and OHT, laser trabeculoplasty has shown to be cost-effective as first choice treatment.
- In advanced glaucoma, early trabeculectomy may be cost-effective when modelled over the patients' life-time.
- In the future, we need glaucoma studies with outcomes that include measures of cost-effectiveness.

The Guidelines project was entirely supported by the European Glaucoma Society Foundation

Br J Ophthalmol: first published as 10.1136/bjophthalmol-2025-egsguidelines on 8 September 2025. Downloaded from http://bjo.bmj.com/ on September 29, 2025 by guest.
Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

I.9 Terminology, classification and definitions

Classification and disease definitions are necessarily arbitrary. A consensus can be reached only if they are acceptable to most ophthalmologists on both theoretical and practical grounds. There are conditions where a precise classification is particularly challenging, such as congenital disorders with associated anomalies.
The following features are to be considered in order to classify and manage the patient (see Fc II-III):

1. Anatomy / Structure (see II.1)
   Open angle, angle closed, optic nerve head, etc.
   E.g. clinical signs, pseudoexfoliation, pigment dispersion

2. Function (see II.1.4)
   Visual acuity
   Visual field

3. Intraocular pressure level (see II.1)
   3.1. At which diagnosis is made (see II.2)
   3.2. Target intraocular pressure (see II.3.3)
   3.3. Identifiable cause (see Fc II)

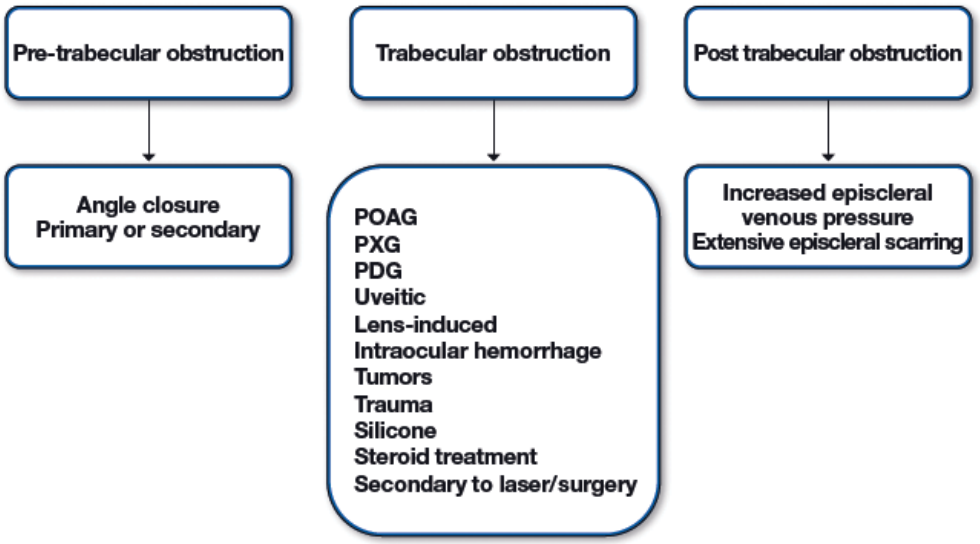
4. General systemic conditions and comorbidities that may affect adherence or life expectanc

Primary open angle glaucoma is a chronic, progressive, potentially blinding, irreversible eye disease causing optic nerve rim and RNFL loss with related visual field defects. The angle is open with a normal appearance, and major risk factors include the level of IOP and older age. Visual disability is usually prevented by early diagnosis and treatment. See Ch II.2.2.

The Guidelines project was entirely supported by the European Glaucoma Society Foundation

Br J Ophthalmol: first published as 10.1136/bjophthalmol-2025-egsguidelines on 8 September 2025. Downloaded from http://bjo.bmj.com/ on September 29, 2025 by guest. Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

FC II Mechanism of IOP increase



© European Glaucoma Society

The Guidelines project was entirely supported by the European Glaucoma Society Foundation

Br J Ophthalmol: first published as 10.1136/bjophthalmol-2025-egsguidelines on 8 September 2025. Downloaded from http://bjo.bmj.com/ on September 29, 2025 by guest.
Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

Br J Ophthalmol: first published as 10.1136/bjophthalmol-2025-egsguidelines on 8 September 2025. Downloaded from http://bjo.bmj.com/ on September 29, 2025 by guest.
Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

The Guidelines project was entirely supported by the European Glaucoma Society Foundation

Br J Ophthalmol: first published as 10.1136/bjophthalmol-2025-egsguidelines on 8 September 2025. Downloaded from http://bjo.bmj.com/ on September 29, 2025 by guest.
Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

Br J Ophthalmol: first published as 10.1136/bjophthalmol-2025-egsguidelines on 8 September 2025. Downloaded from http://bjo.bmj.com/ on September 29, 2025 by guest.
Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

Br J Ophthalmol: first published as 10.1136/bjophthalmol-2025-egsguidelines on 8 September 2025. Downloaded from http://bjo.bmj.com/ on September 29, 2025 by guest.
Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

The Guidelines project was entirely supported by the European Glaucoma Society Foundation

II.1 Patient Examination

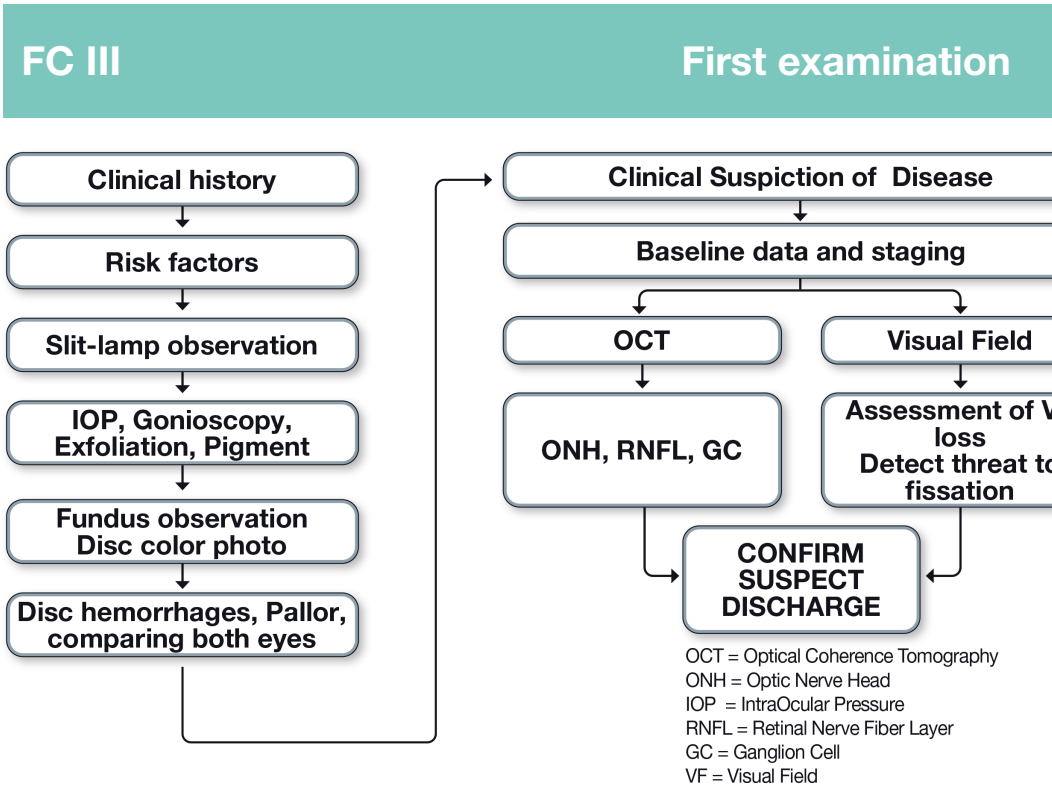
Table II.1.1

Recommended tests at first assessment (See Fc III)
Visual acuity and refractive error
Slit lamp examination
Gonioscopy
Tonometry
Central Corneal thickness (CCT) Use of CCT - adjusted intraocular pressure values is not recommended
Visual field (VF) testing
Clinical assessment of the Optic nerve Head (ONH), Retinal Nerve Fiber Layer (RNFL) and macula Binocular examination under pupil dilation is preferable (except in angle closure) Optic disc and RNFL photography can be used
Optical Coherence Tomography (OCT) of disc/RNFL/macula They are useful but the diagnosis of glaucoma should not be made on the basis of OCT alone

Recommended tests for monitoring (See Fc III)
Visual acuity
VF testing Same instrument and strategy are recommended for follow-up tests Use software-based progression analyses VF remains the most important test to monitor progression
Clinical examination of the optic disc and RNFL
Tonometry
OCT disc/RNFL/macula imaging Using the same instrument with the software-based analyses is useful OCT progression analyses cannot replace VF progression analysis At present OCT progression analysis is not age-corrected (there is an aging-related decline) Apparent OCT progression and VF progression are not always correlated
Repeated gonioscopy in some circumstances **Depends on clinical examination, particularly in phakic patients**

The Guidelines project was entirely supported by the European Glaucoma Society Foundation

Br J Ophthalmol: first published as 10.1136/bjophthalmol-2025-egsguidelines on 8 September 2025. Downloaded from http://bjo.bmj.com/ on September 29, 2025 by guest.
Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.



© European Glaucoma Society

II.1.1 Intraocular Pressure (IOP) and Tonometry

The intraocular pressure (IOP) in the population is approximately normally distributed with a curve skewed to the right. The mean IOP in adult populations is estimated at 15-16 mmHg, with a standard deviation of nearly 3.0 mmHg. Traditionally, the upper bound of normal IOP has been defined as two standard deviations above the mean, i.e. 21 mmHg, and any IOP above this level is considered to be elevated. However, any arbitrary threshold of IOP value alone will be unable to distinguish between health and disease. Higher IOP is a major risk factor for both the development of glaucoma and for its progression (see Ch II.3.3 and Fig II.3.2).

While IOP phasing may provide insights in certain cases, it is not routinely recommended due to its limited repeatability and weak correlation with disease progression. Nonetheless, measuring IOP at different times of the day can be beneficial in selected patients where clinical suspicion warrants closer monitoring.

The Guidelines project was entirely supported by the European Glaucoma Society Foundation

Br J Ophthalmol: first published as 10.1136/bjophthalmol-2025-egsguidelines on 8 September 2025. Downloaded from http://bjo.bmj.com/ on September 29, 2025 by guest.
Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

II.1.1.1 Methods of measurement (tonometry)

Tonometry is based on the relationship between the IOP and the force necessary to deform the natural shape of the cornea by a given amount. Corneal biomechanical properties, such as thickness and elasticity, can affect the IOP measurements independently of the true IOP (Table II.1.2). Tonometers can be classified as contact or non-contact. Some instruments are portable and hand-held.
To obtain reliable IOP measures, it is important to avoid Valsalva's manoeuvre, breath- holding, squeezing the lids or the examiner touching the lids and pressing over the globe, all of which can lead to a momentary increase of the IOP. Furthermore, errors can be due to incorrect technique (Fig. II.1.2) and to the biological variability of the cornea and eye.

Table II.1.2 Influence of corneal status, thickness and tear film on the IOP value measured with Goldmann applanation tonometry.

Cornea Status	IOP reading erroneously high	IOP reading erroneously low
Thin central cornea		x
Thick central cornea	x	
Epithelial oedema		x
Excessive tear film		x
Insufficient tear film	x	
Corneal refractive surgery*		x

** Corneal refractive surgeries alter tonometry reading since they modify thickness, curvature and structure of the cornea.*

The Guidelines project was entirely supported by the European Glaucoma Society Foundation

Br J Ophthalmol: first published as 10.1136/bjophthalmol-2025-egsguidelines on 8 September 2025. Downloaded from http://bjo.bmj.com/ on September 29, 2025 by guest.
Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

II.1.1.1.1 Goldmann Applanation Tonometry (GAT)

The GAT method involves illumination of a biprism tonometer head with a blue light (obtained using a cobalt filter). The prism is used to flatten the anaesthetised cornea which has fluorescein in the tear film. The scaled knob on the side of the instrument is then turned until the inner border of the two hemi-circles of fluorescent tear meniscus, visualised through each prism, just touch (Fig. II.1.1).

The contact with the tear film and the cornea may raise concerns regarding transmissible disease when carrying out GAT. Chemical disinfection or the use of disposable tonometer heads is recommended. The tonometer calibration should be verified regularly according to the manufacturer instructions.

The Perkins tonometer is a portable version of GAT, usable also on supine patients. There has been substantial innovation in tonometry and newer methods (see next section) may challenge GAT's current status as the reference standard.

Technique of Goldmann Applanation Tonometry

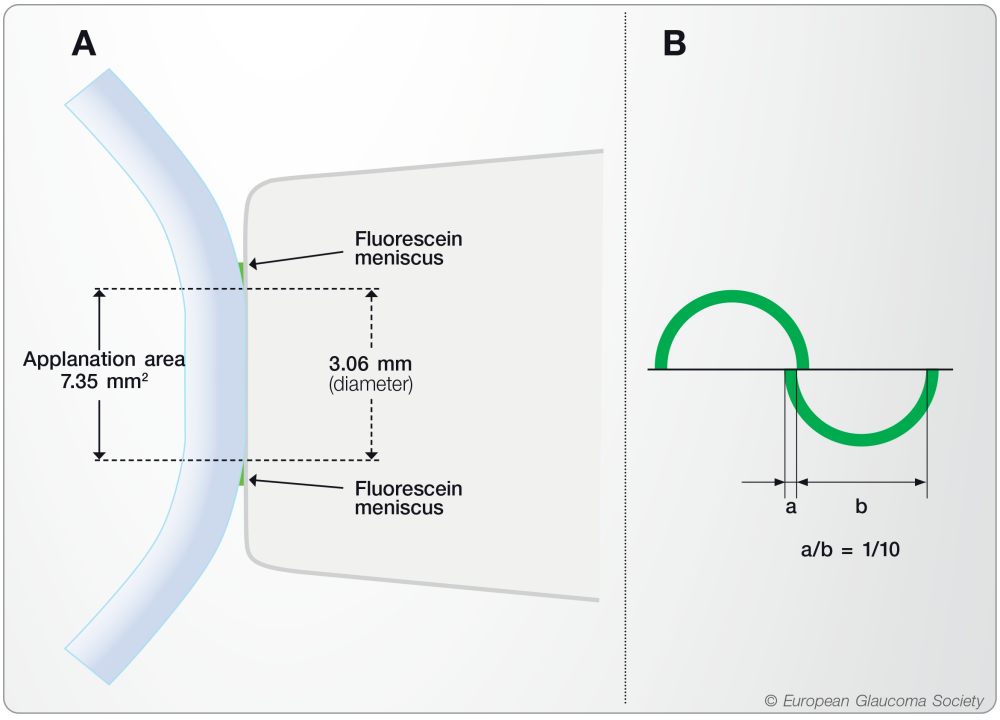
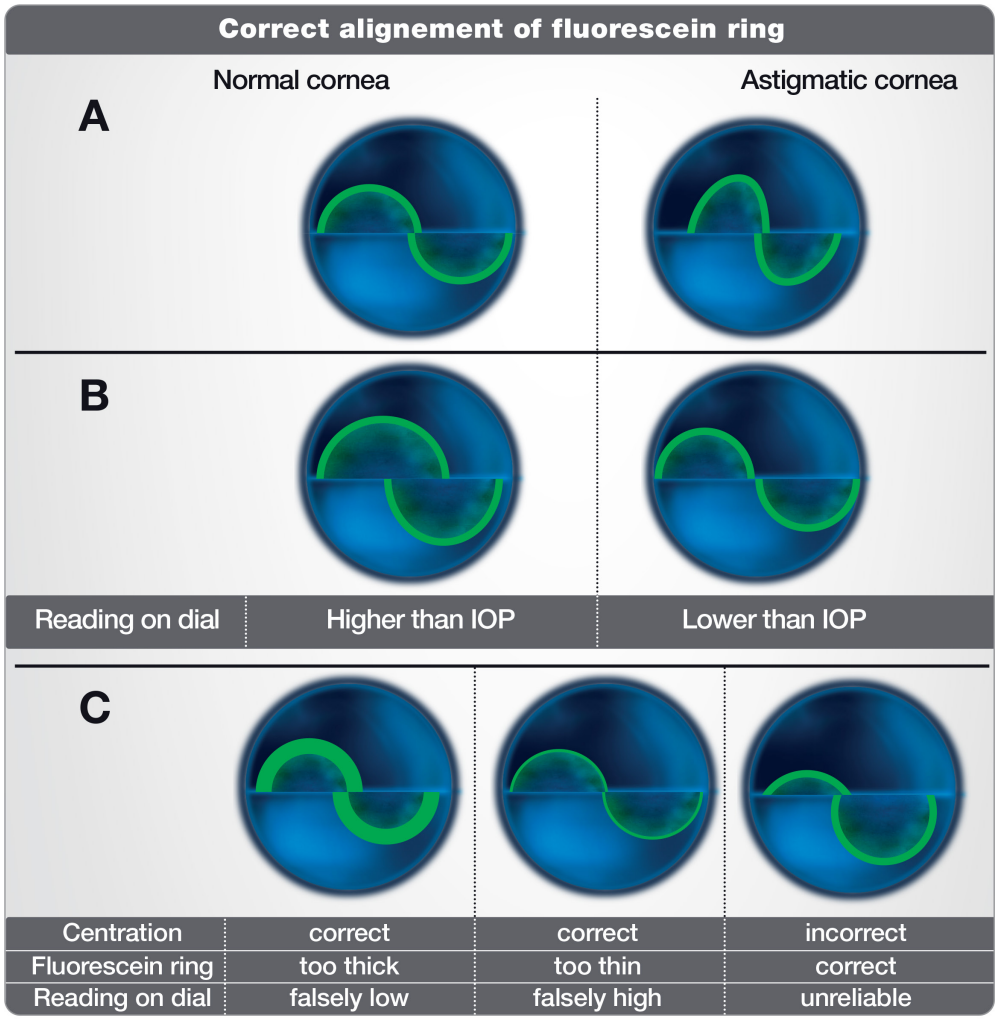


Figure II.1.1 *A) When there is contact between the tonometer prism (right) and the cornea, the stained tear meniscus can be observed through the prism. B) The thickness of the fluorescein meniscus should be about 1/10 of the inner diameter of the hemicircle.*

The Guidelines project was entirely supported by the European Glaucoma Society Foundation

Br J Ophthalmol: first published as 10.1136/bjophthalmol-2025-egsguidelines on 8 September 2025. Downloaded from http://bjo.bmj.com/ on September 29, 2025 by guest.
Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.



© European Glaucoma Society

Figure II.1.2 *The correct technique is shown in (A): the prism is correctly aligned to the centre of the cornea and the applied pressure is then adjusted until the inner part of the hemicircles touch each other. When the reading is taken before the hemicircles are aligned as in (A) or in (B), the applanation pressure will not correspond correctly to the IOP shown on the dial. Incorrect alignment or the wrong amount of fluorescein in the tear film can result in measurement error (C).*

The Guidelines project was entirely supported by the European Glaucoma Society Foundation

Br J Ophthalmol: first published as 10.1136/bjophthalmol-2025-egsguidelines on 8 September 2025. Downloaded from http://bjo.bmj.com/ on September 29, 2025 by guest. Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

II.1.1.1.2 Alternative Tonometers

A complete list of all available technologies is beyond the scope of the Guidelines.

Rebound tonometry
The rebound tonometer is portable and easy to use. Although it is a contact tonometer, topical anaesthetic drops are not required, and the tonometer has a disposable tip to minimise the risk of cross-infection. The device processes the rebound movement of a rod probe resulting from its interaction with the eye; rebound increases (shorter duration of impact) as the IOP increases. The rebound tonometer can be particularly useful in children and in adults with a small palpebral aperture or who cannot sit at a slit-lamp or chin-rest device. iCare is the most common rebound tonometer. With iCare, up to six measurements are taken and their average is displayed. A newer rebound tonometer is the Tono Vera which only takes readings when the device is perpendicularly aligned with the central cornea to avoid artefacts from off-centre readings. A version of rebound tonometry mounted at the slit lamp also exists. Rebound tonometry may be useful for patients with corneal disease and surface irregularity as the area of contact is small.

Ocular Response Analyser (ORA)
The ORA utilises air-puff technology to record two applanation measurements, one while the cornea is moving inward, and the other as the cornea returns towards its normal shape. The average of these two IOP values provides a Goldmann- correlated IOP measurement. The difference between these two IOP readings is called corneal hysteresis, a result of viscous dampening in the corneal tissue. The two applanation measurements provide a basis for two additional new parameters: corneal- compensated IOP (IOPcc) and corneal resistance factor. The corneal-compensated IOP is a measurement that is less affected by the corneal properties. The average of several good quality readings per eye is recommended.

Corvis ST tonometer
The Corvis ST is an air-puff tonometer combined with a high-speed Scheimpflug camera which records the corneal deformation during the air-puff. Outputs include an uncorrected IOP, a corneal biomechanically-corrected IOP and CCT.
The ORA and Corvis tonometers may be least affected by corneal biomechanical artefacts.

Non-contact tonometry (NCT)
The NCT or air-puff tonometry uses a rapid air pulse to flatten the cornea, thus working on the same basic principle as the Goldmann tonometer. The advantages include speed, no need for topical anaesthesia and no direct contact with the eye. NCT may overestimate the IOP in eyes with higher IOP. NCT is not recommended for monitoring glaucoma patients.

Dynamic contour tonometry (DCT)
This slit-lamp mounted instrument contains a sensor tip with a concave surface contour and a miniaturised pressure sensor. The result and a quality score measure are provided digitally. This technique may be less influenced by corneal properties

The Guidelines project was entirely supported by the European Glaucoma Society Foundation

Br J Ophthalmol: first published as 10.1136/bjophthalmol-2025-egsguidelines on 8 September 2025. Downloaded from http://bjo.bmj.com/ on September 29, 2025 by guest.
Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

than GAT. The DCT additionally measures the ocular pulse amplitude which is the difference between the mean systolic and the mean diastolic IOP. The production of the Pascal DCT has been discontinued.

Tono-Pen
The Tono-Pen is a hand-held portable tonometer that determines IOP by making contact with the cornea (central contact is recommended) through a probe tip, causing applanation/indentation of a small area. Topical anaesthetic eye drops are used. After four or ten valid readings are obtained, depending on the instrument model, the averaged measurement is given together with the standard error.

II.1.1.1.3 Self Tonometry

Self-tonometry (e.g., with iCare Home) can be useful to better understand the longer-term level of IOP and variability in patients. Still in the research domain are surgically inserted intraocular IOP sensors which allow patients to easily measure their IOP by holding a receiver device near the eye.

II.1.1.1.4 Measurements in Supine position

Sometimes it is necessary to measure IOP in the supine position, e.g. bedside. Methods include certain versions of iCare, and also Perkins and Tonopen tonometers.

Many forms of tonometry have been licensed for clinical use through comparison with GAT, which is considered the current reference standard.
In general, all measurements with tonometers which applanate the cornea are influenced by corneal biomechanics. This concerns both geometries, e.g. thickness and curvature, and material properties, e.g. stiffness and viscoelasticity which play a role. The effect is greater with tonometers wich applanate the cornea more quickly, such as air-puff and rebound tonometers. The impact of tonometer inaccuracy and/or imprecision on clinical outcomes has not been established.
There is a sizeable inter-and intra-observer variability observed for all tonometers, including GAT.
The accuracy and precision of a tonometer should influence the choice for use in the clinic. For a given patient, the same type of tonometer should be used for follow-up.
See 1.3.2 Q.V.2

The Guidelines project was entirely supported by the European Glaucoma Society Foundation

Br J Ophthalmol: first published as 10.1136/bjophthalmol-2025-egsguidelines on 8 September 2025. Downloaded from http://bjo.bmj.com/ on September 29, 2025 by guest.
Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

II.1.1.2 Intraocular pressure and corneal thickness

Central corneal thickness (CCT) influences tonometry (Table II.1.2). IOP correction algorithms based on CCT are not validated and are highly variable depending on the underlying population that was used to derive the correction coefficients. Therefore, applying a specific correction should be avoided. Rather, the CCT should guide a clinician as to whether there is likely an under- or over-estimation of IOP with their measurements. There are different methods to measure CCT. The normal distribution (mean ± SD) of ultrasonic CCT is approximately 540 ± 30 µm. The association between a thin CCT and a higher risk of glaucoma is likely due to its effect on IOP measurements rather than a true biological relationship with glaucoma pathogenesis. Therefore, CCT should not be used to assess risk of glaucoma in the general population, unless considered together with an IOP reading.
CCT variations after corneal refractive surgery make it difficult to interpret tonometric readings. A record of pre-operative CCT and IOP may be helpful to manage patients undergoing refractive surgery. Tonometers that aim to account for corneal biomechanical properties (see above) may be optimal for post-refractive surgery eyes. For example, the ORA IOPcc measure was optimised to minimise the difference in IOP before and after LASIK.

Corneal properties can have profound effects on IOP measurements. A growing number of patients have had corneal refractive surgery and while aging up to circa 2% are expected to develop glaucoma. Ophthalmologists should be aware that tonometry readings may substantially underestimate IOP in patients treated for the correction of myopia with corneal laser techniques. In such patients a correction using CCT values can only give indications. A tonometer device that aims to correct for dynamic corneal properties may be optimal, and careful monitoring of visual field and/or OCT in such glaucoma patients or suspects is required even with apparently low IOP.

CCT is one parameter which influences the accuracy of most tonometers. In eyes with thin corneas IOP tends to be underestimated and vice versa. Thinner CCT is associated with a higher risk of conversion of ocular hypertension (OHT) to glaucoma and a higher risk of glaucoma progression in multiple variable models. However, there is no strong evidence that CCT is an independent risk factor. IOP corrections based on CCT are not validated and should be avoided. (See I.3.2 Q.V.4)

The Guidelines project was entirely supported by the European Glaucoma Society Foundation

Br J Ophthalmol: first published as 10.1136/bjophthalmol-2025-egsguidelines on 8 September 2025. Downloaded from http://bjo.bmj.com/ on September 29, 2025 by guest.
Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

II.1.2 Gonioscopy

Gonioscopy is essential for evaluating patients suspected of having, or who have all types of glaucoma or ocular hypertension.
The purpose of gonioscopy is to inspect the anterior chamber angle. It is based on the recognition of angle landmarks and must always include an assessment of the following:

- Level of iris insertion, both apparent insertion without indentation and true insertion during indentation
- The shape of the peripheral iris profile, either flat, convex or concave
- Width of the iridocorneal angle between peripheral iris and cornea
- Degree, type and distribution of pigmentation in the trabecular meshwork
- Areas of iridotrabecular apposition or synechia
- Any abnormal or postoperative findings

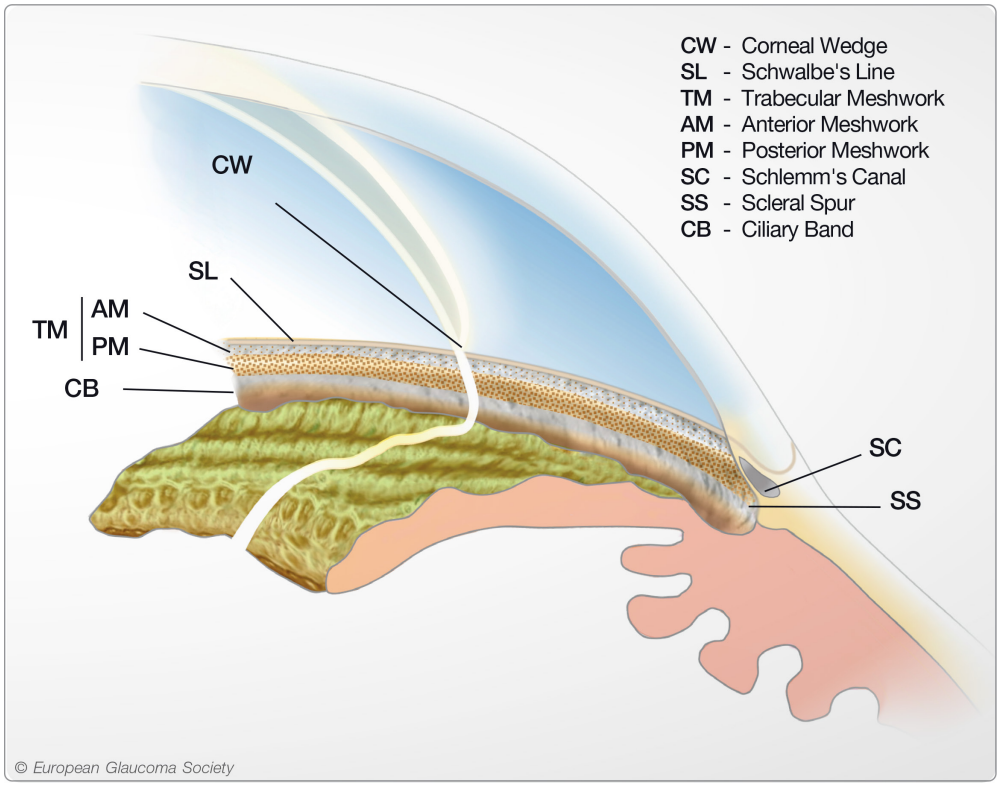


Figure II.1.3 *The 'corneal wedge', is a gonioscopy technique that helps the examiner identify the Schwalbe's line in patients where the anterior border of the TM is difficult to see, either because of a lack of pigment or because of excessive pigment. By aiming a thin bright slit at the peripheral cornea, the point where the anterior and posterior reflections of the optical section of the cornea meet identifies Schwalbe's line.*

The Guidelines project was entirely supported by the European Glaucoma Society Foundation

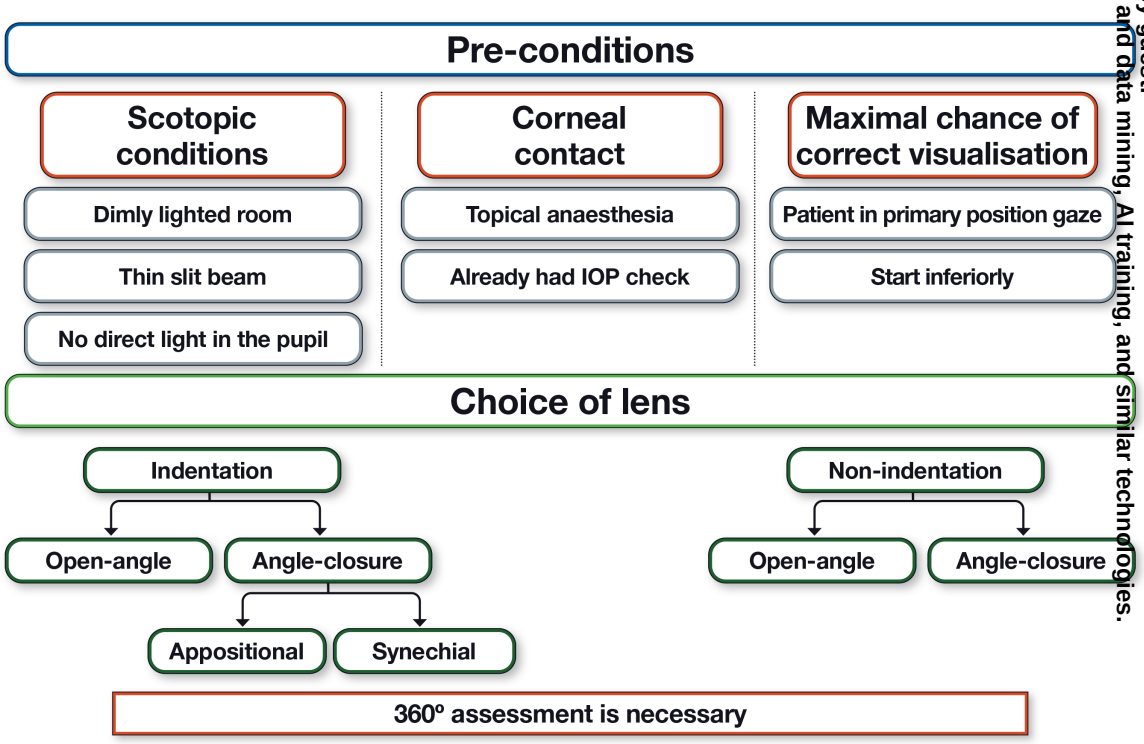
Br J Ophthalmol: first published as 10.1136/bjophthalmol-2025-egsguidelines on 8 September 2025. Downloaded from http://bjo.bmj.com/ on September 29, 2025 by guest. Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

II.1.2.1 Anatomy

II.1.2.1.1 Reference Landmarks

Schwalbe's line: this collagen condensation of the Descemet's membrane between the trabecular meshwork (TM) and the corneal endothelium appears as a thin translucent line. Schwalbe's line may be prominent and anteriorly displaced (posterior embryotoxon), or there may be heavy pigmentation over it. A pigmented Schwalbe's line (e.g. Sampaolesi's line) may be misinterpreted as the TM, particularly when the iris is convex and the angle is narrow. The corneal wedge method is helpful to distinguish between the structures by reliably identifying Schwalbe's line; this technique is particularly useful in cases of pale or poorly defined angle structures. Identifying Schwalbe's line is a good starting point when performing gonioscopy (See Fig. II.1.3).

FC IV **Gonioscopy technique**



© European Glaucoma Society

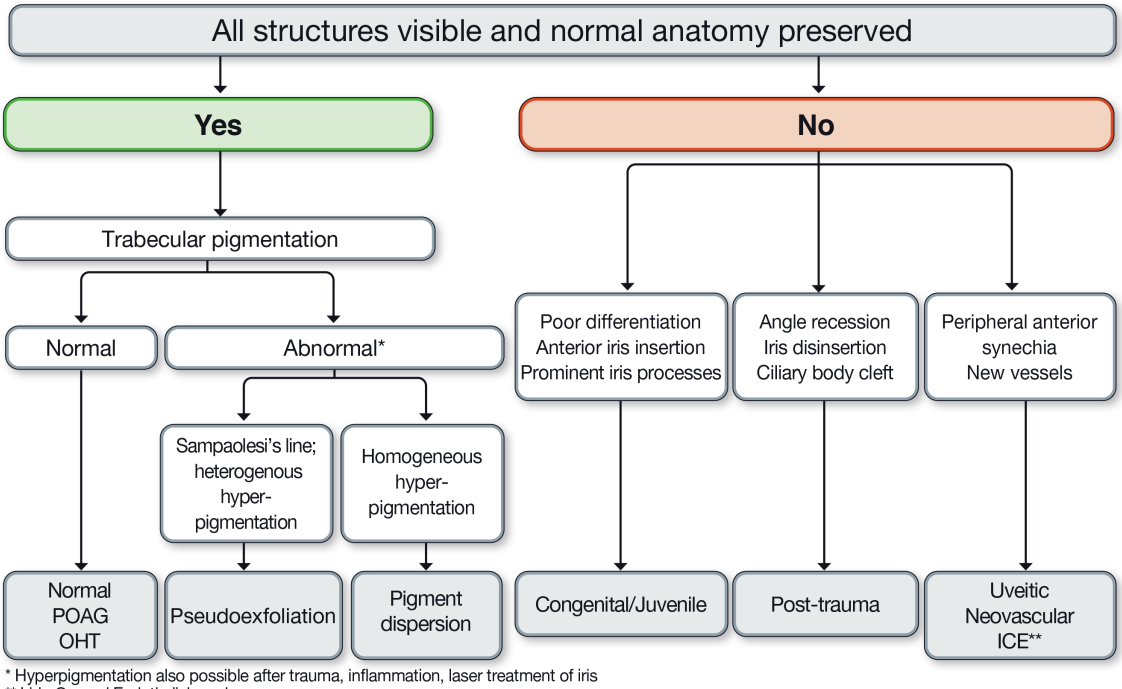
The Guidelines project was entirely supported by the European Glaucoma Society Foundation

Br J Ophthalmol: first published as 10.1136/bjophthalmol-2025-egsguidelines on 8 September 2025. Downloaded from http://bjo.bmj.com/ on September 29, 2025 by guest. Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

Trabecular Meshwork (TM): extends posteriorly from Schwalbe's line to the scleral spur. Close to Schwalbe's line is the non-functional TM, which blends into the posterior, functional, and often pigmented TM. Most difficulties concerning the examination of the TM relate to determining whether observed features are normal o pathological (particularly pigmentation), blood vessels, and iris processes. Indentation ('dynamic') gonioscopy helps to visualise TM in angle closure (See Fig II.1.6).

Schlemm's canal: it is located anterior to the scleral spur, and it is not visible, though it may be seen if it contains blood. Blood reflux from episcleral veins may occur in cases of carotid-cavernous fistulae, Sturge Weber syndrome, venous compression, ocular hypotony, sickle cell disease or due to suction from the goniolens during gonioscopy.

FC V Diagnostic gonioscopy in open angle glaucoma



* Hyperpigmentation also possible after trauma, inflammation, laser treatment of iris
** Irido Corneal Endothelial syndrome

© European Glaucoma Society

The Guidelines project was entirely supported by the European Glaucoma Society Foundation

Br J Ophthalmol: first published as 10.1136/bjophthalmol-2025-egsguidelines on 8 September 2025. Downloaded from http://bjo.bmj.com/ on September 29, 2025 by guest. Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

Scleral spur: is of white appearance and located between the pigmented TM and the ciliary body. The angle is undoubtedly open if the scleral spur is visible. The scleral spur is a useful landmark in gonioscopy because it is relatively consistent in appearance and has less variability than other landmarks.

Ciliary band and iris root: the iris insertion is usually located at the anterior face of the ciliary body, though the site is variable. The ciliary band may be wide, as in myopia, aphakia or following trauma, or narrow or not seen as in hyperopia, angle closure and anterior insertion of the iris.

Pigmentation: pigment is found predominantly in the posterior TM. It is seen in adults, rarely before puberty and the extent can be highly variable. The most common conditions associated with dense pigmentation are PXF, pigment dispersion syndrome (PDS), previous trauma, previous laser treatment of the iris, uveitis and after angle- closure episodes. The inferior angle is usually the most open and pigmented. In older patients, the pigment reversal sign, where the trabecular meshwork appears darker in the superior quadrant than in the inferior quadrant is a sign suggesting previous PDS.

II.1.2.1.2 Other anatomical features

Blood vessels: these are often found in normal iridocorneal angles in subjects with blue/light irides. They characteristically have a radial or circumferential orientation, have few anastomoses and do not run across the scleral spur. Pathological vessels e.g., neovascularisation, are usually thinner, have a disordered orientation and run across the scleral spur. Abnormal vessels are also seen in Fuchs' heterochromic iridocyclitis and chronic anterior uveitis.

Iris processes: are present in one-third of normal eyes and are more evident in younger subjects. When numerous and prominent, they may represent a form of Axenfeld-Rieger syndrome/anomaly. They are distinguished from goniosynechiae, which are thicker and wider and may go beyond the scleral spur.

Post-traumatic findings in eye injuries

Gonioscopy is crucial after an eye injury to assess potential angle damage, with a comparison between both eyes essential for detecting subtle abnormalities (see the Traumatic Glaucoma chapter). However, gonioscopy should not be performed in suspected or confirmed open globe injuries. Post-traumatic alterations in the angle include:

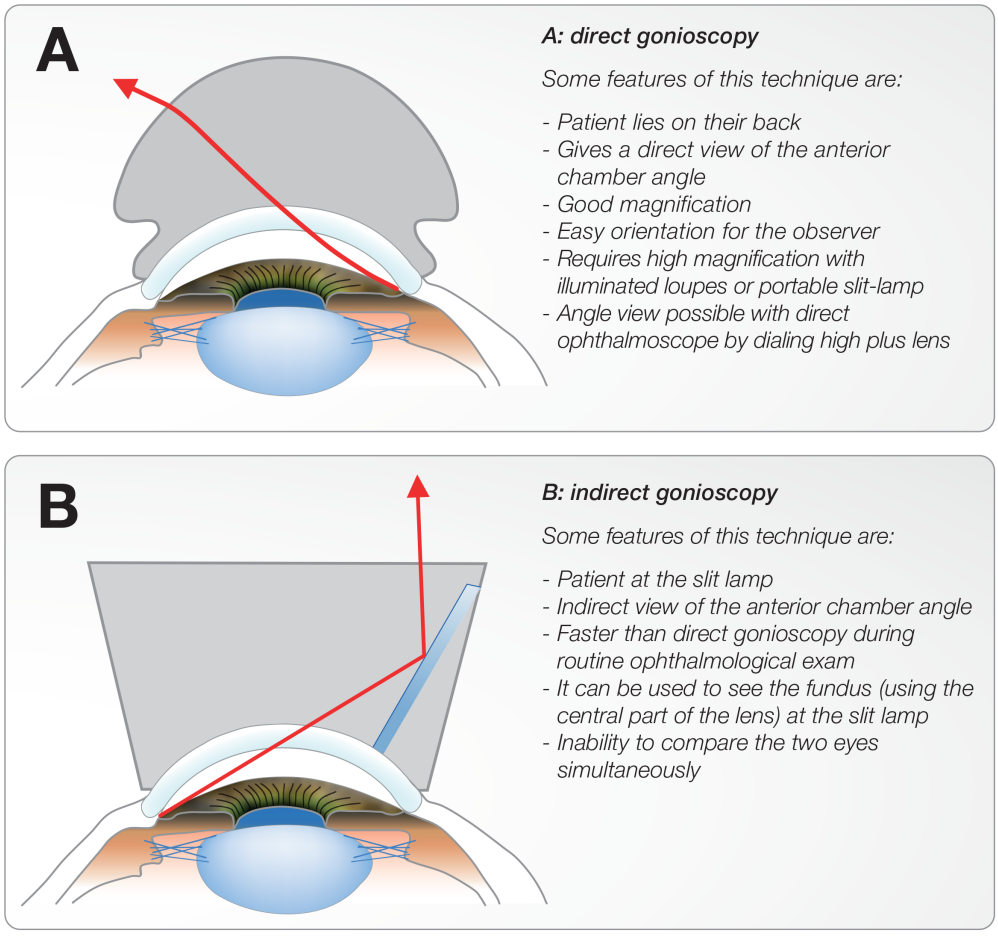
- **Angle recession:** this involves a laceration between the longitudinal and circular muscles of the ciliary body. Gonioscopic findings include a widened ciliary body band and retroplacement of the iris root in the affected area, compared to other sectors or the same area of the unaffected eye. Hyphema or microhyphema and increased anterior chamber depth may also be indicative of angle recession.
- **Iris disinsertion (or iridodialysis):** this involves rupture of the iris root. Small iris disinsertions can be detected as transillumination defects at the slit lamp.
- **Ciliary body cleft (or cyclodialysis):** this refers to detachment of the ciliary body from the scleral spur. Small clefts may be challenging to detect through gonioscopy alone and may require imaging techniques such as UBM or as OCT and in some cases exploration in the operating theatre.

The Guidelines project was entirely supported by the European Glaucoma Society Foundation

Br J Ophthalmol: first published as 10.1136/bjophthalmol-2025-egsguidelines on 8 September 2025. Downloaded from http://bjo.bmj.com/ on September 29, 2025 by guest. Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

II.1.2.2 Techniques

Gonioscopy should be performed in a dimly-lit room, using a thin slit beam, taking care to avoid shining the light through the pupil. Pupil constriction on light exposure opens the angle, resulting in underestimating the risk of angle closure.
Angle width grading must be performed with the eye in primary position to avoid misclassification. If the patient looks in the direction of the mirror, the angle appears wider and vice versa. A common pitfall is inadvertent pressure over the cornea, which will push back the iris and give an erroneously wide appearance to the angle. All precautions should be taken to sterilize the goniolens. IOP measurements must be performed before gonioscopy. Both eyes should always be examined. (See Fc IV and V).



© European Glaucoma Society

Figure II.1.4

The Guidelines project was entirely supported by the European Glaucoma Society Foundation

Br J Ophthalmol: first published as 10.1136/bjophthalmol-2025-egsguidelines on 8 September 2025. Downloaded from http://bjo.bmj.com/ on September 29, 2025 by guest. Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

There are two main techniques for viewing the anterior chamber angle:

Direct gonioscopy
The use of some contact goniolenses like the Koeppe or Barkan lens permits the light from the anterior chamber to pass through the cornea so that the angle may be viewed (Fig. II.1.4 A). The patient is in supine position during the exam.
There are direct goniolens for use at the slit lamp (e.g. Khaw's lens).

Indirect gonioscopy
The light from the anterior chamber is made to exit via a mirror built into a contact glass (Fig. II.1.4 B). Generally, the patient is in sitting position during the exam. The 4-mirror indirect lenses do not exert any suction and may be used early postoperatively.

Common gonioscopy lenses:

Direct	Koeppe (contact fluid required) Layden (sized for infants; contact fluid required) Worst Swan-Jacob Khaw
Indirect	Posner, Volk, Zeiss, Sussman, Gaasterland or Khaw 4-mirror (contact fluid not required) Goldmann-type lens (contact fluid required); Magnaview (contact fluid required)

II.1.2.2.1 Gonioscopy technique without indentation

The patient should be instructed to look straight ahead. With indirect Goldmann-type lenses, it is helpful to start by viewing the inferior angle, which often appears wider and more pigmented than the superior angle. Then, it is helpful to continue rotating the mirror. The anterior surface of the lens should be kept perpendicular to the observation axis so that the appearance of the angle structure is not changed as the examination proceeds. The four quadrants are examined by combining slit-lamp movements and prism rotation.

The Guidelines project was entirely supported by the European Glaucoma Society Foundation

Br J Ophthalmol: first published as 10.1136/bjophthalmol-2025-egsguidelines on 8 September 2025. Downloaded from http://bjo.bmj.com/ on September 29, 2025 by guest.
Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

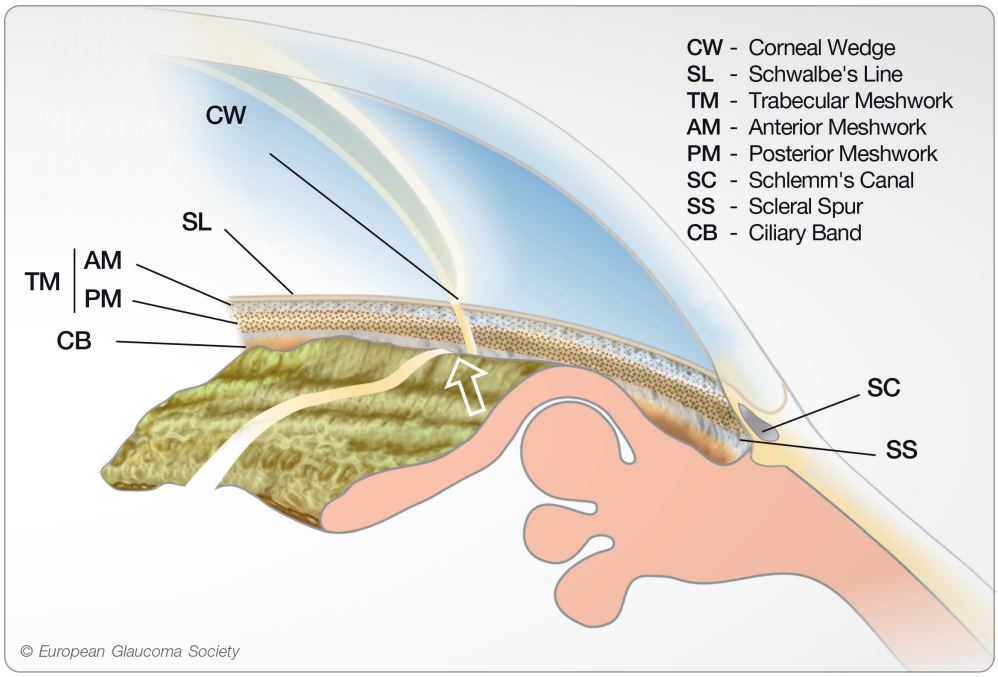


Figure II.1.5 *The "double hump" is a sign observed in plateau irs. Arrow: double hump.*

II.1.2.2.2 Dynamic gonioscopy by indentation or compression

It is recommended to use a small diameter lens for indentation (e.g. 4-mirror). When gentle pressure is applied by the lens on the centre of the cornea, the aqueous humour (AH) and iris are pushed back. In appositional angle closure, the angle can be re-opened. If there is adhesion between the iris and the meshwork, as with goniosynechiae, that portion of angle remains closed (Fig. II.1.6-3).

When pupillary block is the prevalent mechanism, the iris becomes peripherally concave during indentation (Fig. II.1.6-2). In plateau configuration, this iris concavity will not be extended by indentation to the extreme periphery, which is a sign of anteriorly placed ciliary processes called double hump sign (Fig II.1.5). When the crystalline lens has a particularly prominent role in angle closure, indentation causes the iris to move only slightly backwards, retaining a convex profile (Fig. II.1.6-4).

> To differentiate appositional from synechial closure "indentation" or "compression" dynamic gonioscopy is essential.

The Guidelines project was entirely supported by the European Glaucoma Society Foundation

Br J Ophthalmol: first published as 10.1136/bjophthalmol-2025-egsguidelines on 8 September 2025. Downloaded from http://bjo.bmj.com/ on September 29, 2025 by guest. Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

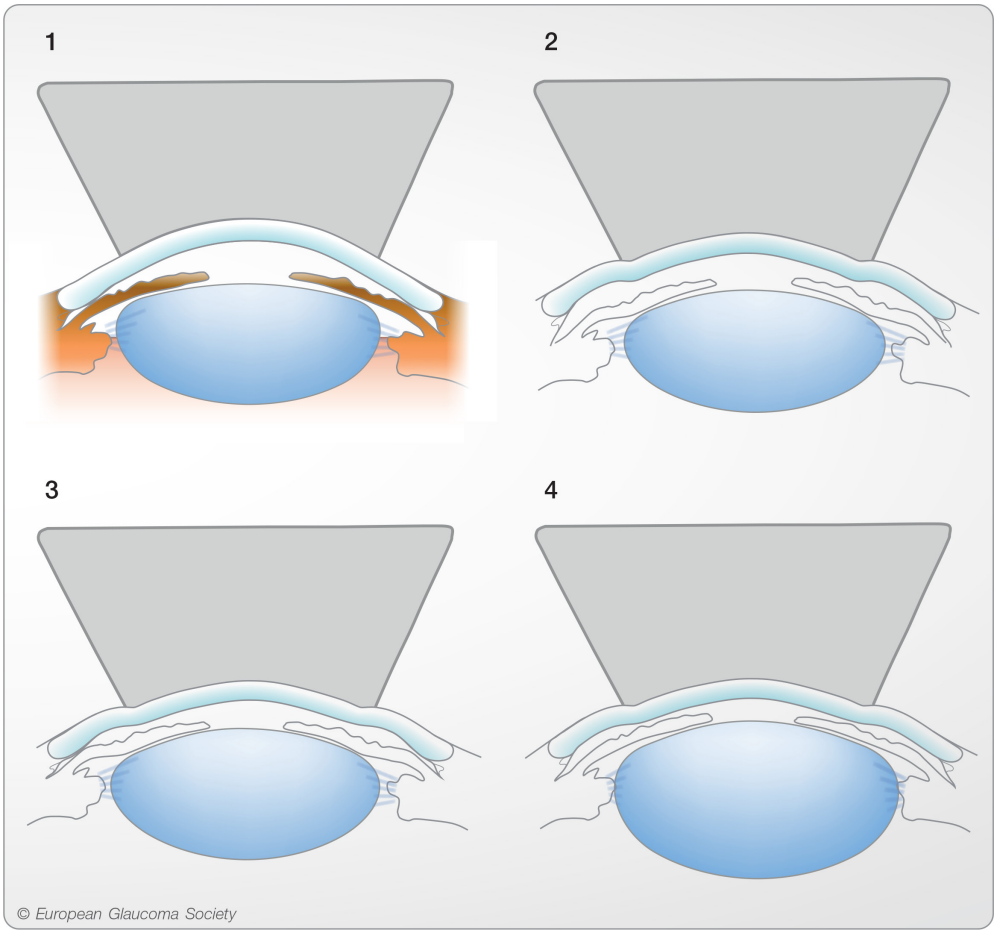


Figure II.1.6 *Dynamic indentation gonioscopy. When no angle structure is directly visible before indentation, angle closure may be present, and it can be synechial or appositional (1). If during indentation the iris moves peripherally backwards and the angle recess widens (2), the picture in (1) is to be interpreted as appositional closure and a suspicion of relative pupillary block is raised (2). When during indentation the angle widens but iris strands remain attached to the angle outer wall (3), the picture in (1) is to be interpreted as synechial closure. A large and/or anteriorly displaced lens causes the iris to move only slightly and evenly backwards during indentation (4) making the lens a likely component of angle closure.*

The Guidelines project was entirely supported by the European Glaucoma Society Foundation

Br J Ophthalmol: first published as 10.1136/bjophthalmol-2025-egsguidelines on 8 September 2025. Downloaded from http://bjo.bmj.com/ on September 29, 2025 by guest.
Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

II.1.2.2.3 Intraoperative gonioscopy

An essential technique for angle surgery. Proficiency with gonioscopy at the slit lamp is a necessary prerequisite.

Gonioscopy should be performed in every patient being evaluated for glaucoma or ocular hypertension.
Always perform gonioscopy on both eyes of patients with ocular hypertension, suspicion of glaucoma or confirmed glaucoma.
Gonioscopy may affect subsequent IOP measurement and should be performed afterwards.

II.1.2.3 Grading of the anterior chamber angle

The use of a grading system for gonioscopy is recommended. It encourages the observer to use a systematic approach in evaluating angle anatomy, allows comparison of findings at different times in the same patients, and classification of the angle.
The Spaeth gonioscopy grading system is the most detailed (Fig. II.1.7).
Other practical grading systems are those of Shaffer and Kanski; both are based on angle width and visibility of the angle structures.

II.1.2.3.1 Slit lamp-grading of peripheral AC depth- The Van Herick method

The Van Herick grading (Fig. II.1.8) is an indirect estimation of angle width. The Van Herick technique does not replace gonioscopy but can be a crude case-finding tool to prompt verification by gonioscopy.
This technique is based on the use of corneal thickness as a unit measure of the depth of the anterior chamber at the furthest periphery, preferably on the temporal side. The slit lamp light beam should be at 60 degrees. Grade 0 represents iridocorneal contact, i.e., angle closure. A space between iris and corneal endothelium of less than 1/4 corneal thickness is interpreted as a high risk of anatomical angle closure. When the space is between 1/4 and 1/2 corneal thickness the grade is 2, with a very low risk of angle closure. A grade 3 is not occludable, with an irido/endothelial distance more than 1/2 corneal thickness. Alternatively, the peripheral anterior chamber depth may be expressed as a percentage of the peripheral corneal width.

The Van Herick technique does not replace gonioscopy but can be a crude case-finding tool to prompt verification by gonioscopy

The Guidelines project was entirely supported by the European Glaucoma Society Foundation

Br J Ophthalmol: first published as 10.1136/bjophthalmol-2025-egsguidelines on 8 September 2025. Downloaded from http://bjo.bmj.com/ on September 29, 2025 by guest.
Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

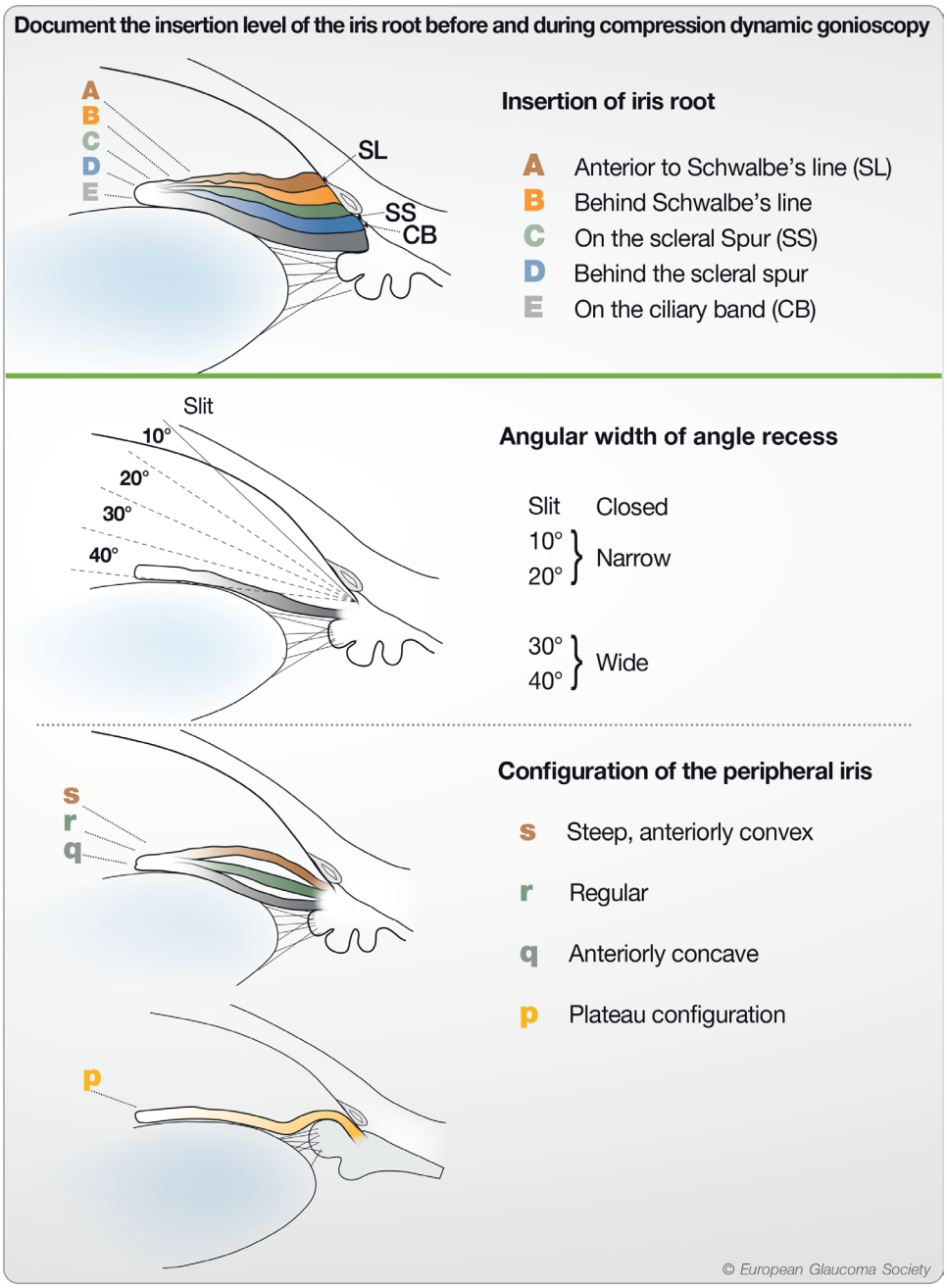


Figure II.1.7 *The Spaeth Grading System of gonioscopy findings.*

The Guidelines project was entirely supported by the European Glaucoma Society Foundation

Br J Ophthalmol: first published as 10.1136/bjophthalmol-2025-egsguidelines on 8 September 2025. Downloaded from http://bjo.bmj.com/ on September 29, 2025 by guest.
Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

II.1.2.4 Anterior segment imaging techniques

Anterior segment imaging such as ultrasound biomicroscopy (UBM), anterior segment OCTs (AS-OCT) and Scheimpflug cameras can be useful in some circumstances but cannot replace gonioscopy. Added to gonioscopy, imaging techniques may help elucidate the mechanism of angle closure. UBM can be particularly helpful as – in contrast to AS-OCT – it can image tissues behind the iris (anteriorly placed iris processes in plateau iris, tumours, cysts). Anterior segment imaging provides quantitative angle measurements and helps document the chamber angle dynamics with different light conditions. Anterior segment imaging may classify more eyes as having angle closure than gonioscopy, thus leading to overdiagnosis. Automated 360º goniophotography is also available.

A recent meta-analysis indicated that AS-OCT was not superior to the Van Herick test in detecting angle closure, OCT for angle evaluation has proven to be useful in virtual clinic settings as it allows for asynchronous evaluation of the angle.

Unlike gonioscopy, where various lenses provide similar optical quality, the definition of an AS-OCT scan greatly depends on the specific technology and settings. For example, spectral-domain OCT may not always identify the scleral spur, which is used as a landmark for angle-closure detection, whereas Schwalbe's line is more easily identified. Some devices allow simultaneous scanning of multiple quadrants, while most only allow scanning one sector at a time. The superior quadrant is not adequately assessed by AS-OCT due to the presence of the lid.

These differences make the results of AS-OCT studies weakly generalizable. Again, diagnostic and therapeutic algorithms are based on gonioscopy and AS-OCT results alone cannot be directly translated into clinical decisions.

Systematic reviews:

– Jindal A, Ctori I, Virgili G, Lucenteforte E, Lawrenson JG. Non-contact tests for identifying people at risk of primary angle closure glaucoma. Cochrane Database of Systematic Reviews 2020, Issue 5. Art. No.: CD012947. DOI10.1002/14651858.CD012947.pub2.

Anterior chamber angle imaging devices can be useful to identify the iris configuration of a narrow angle, to assess the influence of the lens, for triage or in iris where the angle cannot be visualised by gonioscopy. However, anterior chamber angle imaging should not replace gonioscopy since features such as peripheral anterior synechia, pigment and other secondary causes of trabecular dysfunction may be missed.
See I.3.2 Q.V.5

The Guidelines project was entirely supported by the European Glaucoma Society Foundation

Br J Ophthalmol: first published as 10.1136/bjophthalmol-2025-egsguidelines on 8 September 2025. Downloaded from http://bjo.bmj.com/ on September 29, 2025 by guest. Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

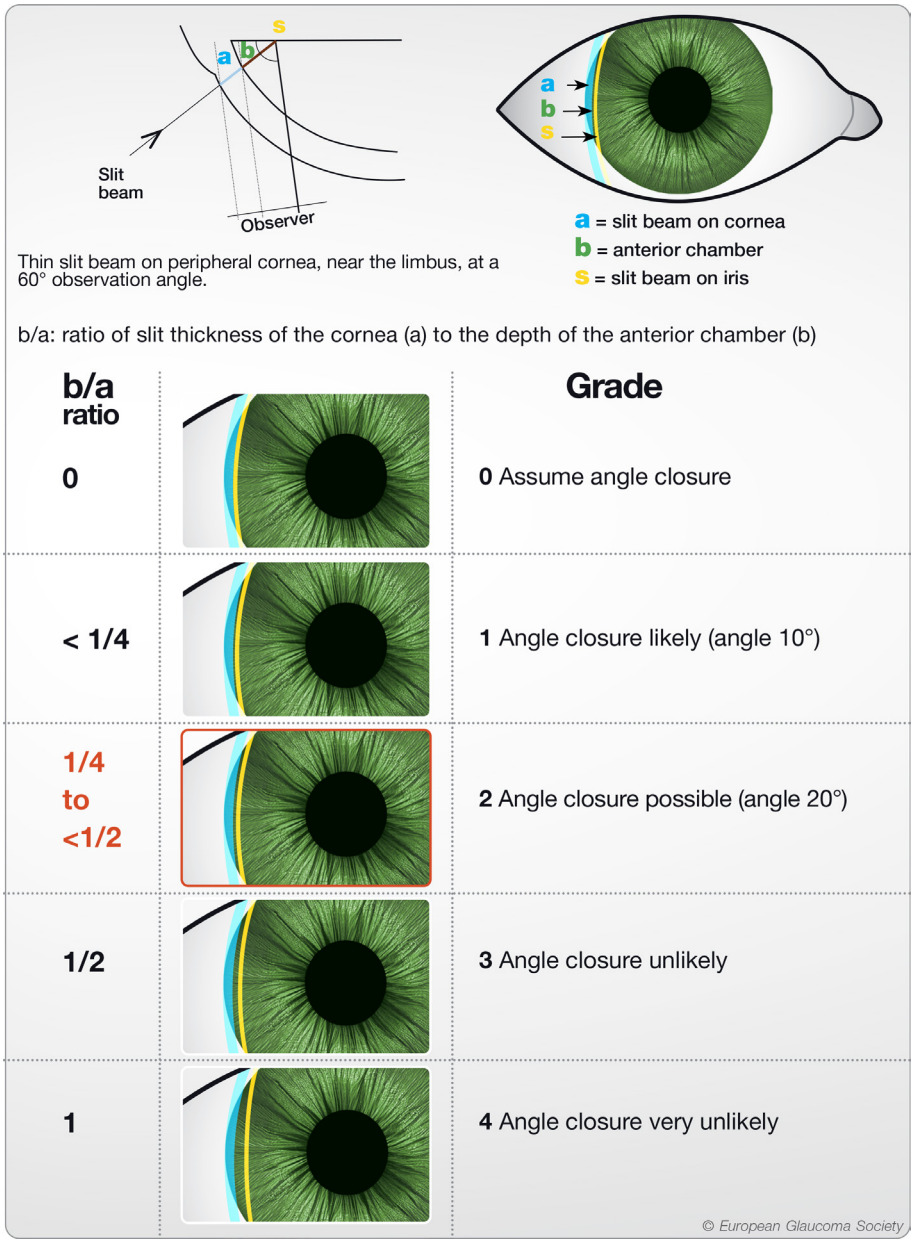


Figure II.1.8 *The Van Herick test (see II.1.2.3.1). This is not a substitute for gonioscopy.*

The Guidelines project was entirely supported by the European Glaucoma Society Foundation

Br J Ophthalmol: first published as 10.1136/bjophthalmol-2025-egsguidelines on 8 September 2025. Downloaded from http://bjo.bmj.com/ on September 29, 2025 by guest.
Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

II.1.3 Optic nerve head and retinal nerve fibre layer

Glaucoma changes the appearance of the ONH, particularly the neuroretinal rim and vessels, and the RNFL in a characteristic fashion.
Contour changes can best be appreciated with a magnified stereoscopic view preferably through a dilated pupil. Interim examinations, aimed at detecting striking features such as disc haemorrhages, may be performed through an undilated pupil. Stereoscopic examination of the posterior pole is best performed at the slit lamp with either:

- Indirect non-contact fundus lens with sufficient magnification
- Direct contact fundus lens

The direct ophthalmoscope is used for monoscopic view of ONH and RNFL examination (Fig. II). The clinical evaluation of the ONH and RNFL should assess the following features.

II.1.3.1 Clinical examination

II.1.3.1.1 Neuroretinal rim

In a healthy eye, the shape of the rim is influenced by size, shape and tilting of the ONH. The disc is usually slightly vertically oval, often more so in African ancestry subjects who may also have larger discs. In medium-size discs, the neuroretinal rim is typically at least as wide at the 12 and 6 o'clock positions as elsewhere and usually widest in the inferotemporal sector, followed by the supero-temporal, nasal and then temporal sectors (Fig. II.1.9). This pattern, described as ISNT distribution, is less obvious in larger discs, in which the rim is distributed more evenly and in a smaller discs where cupping may not be evident. In small discs the changes associated with glaucoma may not result in cupping, but 'saucerization' of the disc surface instead. In large optic discs the normal rim width is relatively narrow and can potentially be misinterpreted as glaucomatous. The exit of the optic nerve from the eye may be oblique, giving rise to a tilted disc. Tilted discs are more common in myopic eyes, and show a wider, gently sloping rim in one disc sector in the direction of the tilt and a narrower, more sharply-defined rim in the opposite sector. Discs in highly myopic eyes are even harder to interpret.
Glaucoma is characterised by progressive narrowing of the neuroretinal rim. The pattern of rim loss varies and may take the form of diffuse narrowing, localised notching, or both in combination. Narrowing of the rim, while occurring in all disc sectors, is generally more common and greatest at the inferior and superior poles (Fig. II.I.10).

The Guidelines project was entirely supported by the European Glaucoma Society Foundation

Br J Ophthalmol: first published as 10.1136/bjophthalmol-2025-egsguidelines on 8 September 2025. Downloaded from http://bjo.bmj.com/ on September 29, 2025 by guest.
Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

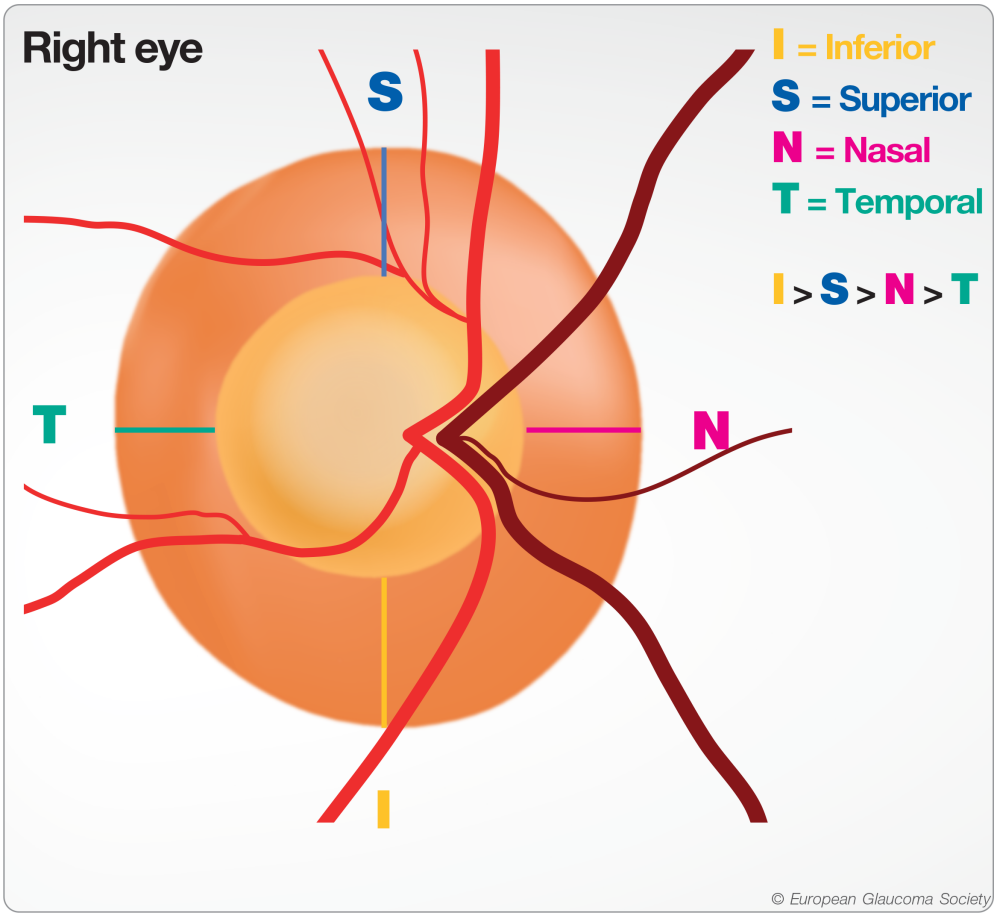


Figure II.1.9 *The ISNT rule.*

The Guidelines project was entirely supported by the European Glaucoma Society Foundation

Br J Ophthalmol: first published as 10.1136/bjophthalmol-2025-egsguidelines on 8 September 2025. Downloaded from http://bjo.bmj.com/ on September 29, 2025 by guest.
Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

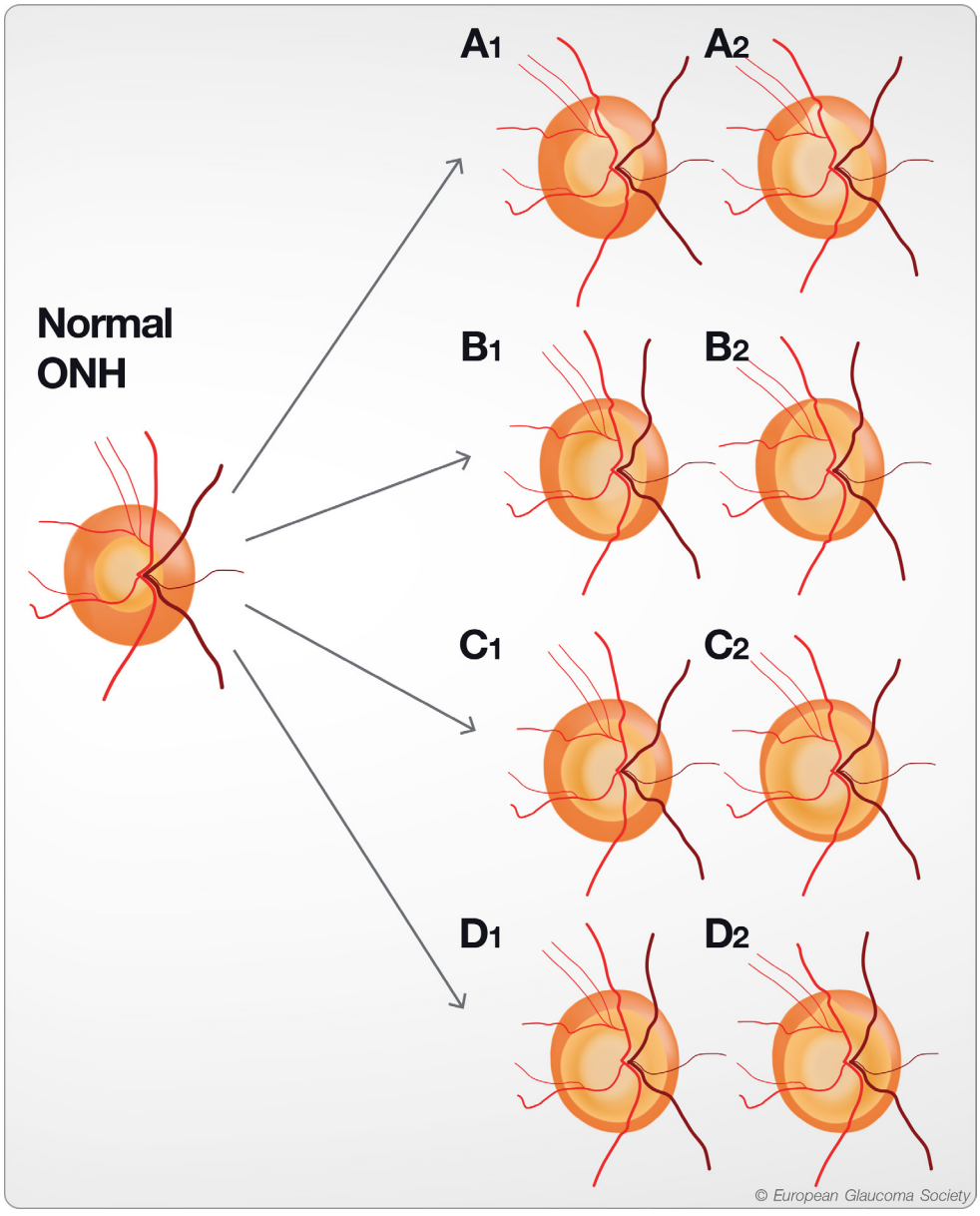


Figure II.1.10 *Worsening of glaucomatous damage at the optic disc:*
Early localised loss (A1), advancing to localised in US plus diffuse rim loss (A2).
Early localised rim loss, polar notches (B1); more advanced polar notches (B2). Diffuse or concentric rim loss, early (C1); advanced (C2).
Diffuse rim loss (D1), followed by localised rim loss (notch) (D2).

The Guidelines project was entirely supported by the European Glaucoma Society Foundation

Br J Ophthalmol: first published as 10.1136/bjophthalmol-2025-egsguidelines on 8 September 2025. Downloaded from http://bjo.bmj.com/ on September 29, 2025 by guest. Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

II.1.3.1.2 Retinal nerve fibre layer

The RNFL appearance can be best assessed in the central 60° at the posterior pole with a blue filter photograph. Clinically at the slit lamp, the RNFL is best evaluated with a red-free light and low magnification and/or with a short, narrow beam of bright white light at high magnification around the circumference of the optic disc within about two-disc diameters of the disc margin. The RNFL surface is best seen if the focus is adjusted just anterior to the main retinal vessels. The fibre bundles are seen as radial silver striations around the disc, slit-like. Groove- like, or spindle-shaped apparent defects, narrower than the retinal vessels, may be seen in the normal fundus. The RNFL may become less visible with age and is more difficult to see in less pigmented fundi. Local (wedge and slit) defects are seen as dark bands, wider than retinal vessels which will extend to the disc margin. These local defects are more easily seen than generalised thinning of the RNFL, which manifests as a loss of brightness and density of striations. When the RNFL is thinned, the blood vessel walls appear sharp against a matt and mottled back- ground. The initial abnormality in glaucoma may be either diffuse thinning or localised defects.

II.1.3.1.3 Optic disc haemorrhages

A large proportion of glaucoma patients has optic disc haemorrhages at one time or another (Fig. II.1.11) and sometimes are very subtle. Often overlooked at clinical examinations, they are easier to find in photographs. OCT cannot visualise disc

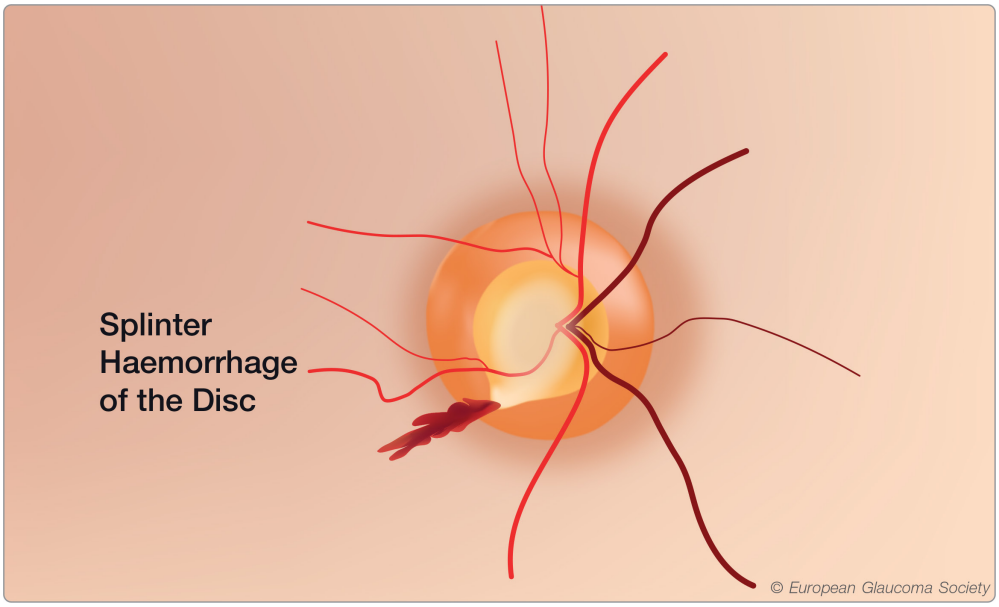


Figure II.1.11 *Optic disc haemorrhage.*

The Guidelines project was entirely supported by the European Glaucoma Society Foundation

Br J Ophthalmol: first published as 10.1136/bjophthalmol-2025-egsguidelines on 8 September 2025. Downloaded from http://bjo.bmj.com/ on September 29, 2025 by guest.
Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

haemorrages. Disc haemorrhages can also be overseen when they persist for periods shorter than the examination schedule. The clinical examination should include actively looking for disc haemorrhages. Many studies have shown that optic disc haemorrhages are associated with a higher risk for glaucomatous VF progression in the next 2 years.

II.1.3.1.4 Vessels at the optic disc

Narrowing of the neuroretinal tissue will change the position of the vessels at the optic disc with bending, bayoneting or baring of circumlinear vessels. Those positional changes are particularly important to observe when looking for progression, and can be detected with sequential photographs. It is important to remember that circumlinear vessels can help to detect the inner edge of the rim and are not a sign of glaucoma *per se*; the suspicion of disease may arise when the rim recedes and leaves a space under them.

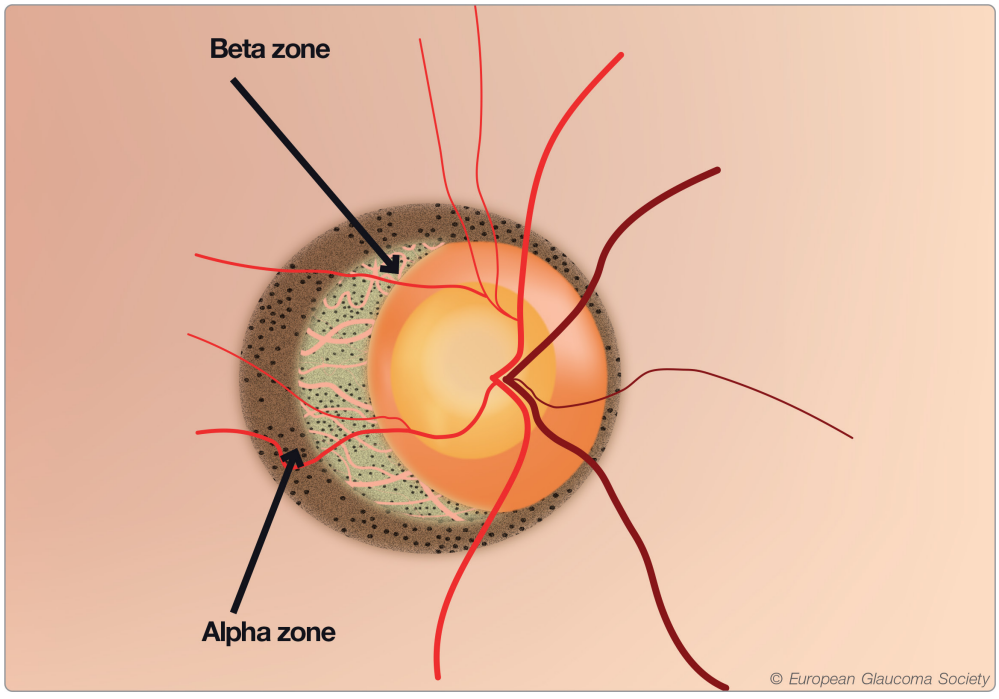


Figure II.1.12 *ONH with parapapillary atrophy. The Alpha zone is located peripheral to Beta zone, and is characterized by irregular hypo- and hyperpigmentation.*
The Beta zone of atrophy is adjacent to the optic disc edge, external to Elschnig's ring (a white circular band that separates the intra- from the peri-papillary area of the optic disc), with visible sclera and large choroidal vessels.

The Guidelines project was entirely supported by the European Glaucoma Society Foundation

Br J Ophthalmol: first published as 10.1136/bjophthalmol-2025-egsguidelines on 8 September 2025. Downloaded from http://bjo.bmj.com/ on September 29, 2025 by guest. Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

II.1.3.1.5 Parapapillary atrophy

Parapapillary atrophy can be differentiated into an alpha zone, which is present in most eyes, and into a beta zone, which is present in some normal eyes and in a high percentage of eyes with glaucoma. Beta parapapillary atrophy is common in myopic and older eyes. In clinical practice, a large beta zone can be regarded as a clue, but not as a definite sign of glaucoma (Fig. II.1.12), However, the area can increase in glaucomatous patients during follow-up.

II.1.3.1.6 Optic disc size (vertical disc diameter)

The optic disc size greatly varies in the population. The width of the rim and the size of the cup vary with the overall size of the disc. The mean vertical disc diameter is approximately 1.9 mm. The vertical diameter of the optic disc can be measured at the slit lamp using a hand held high power convex lens. The slit beam should be coaxial with the observation axis; a narrow beam is used to measure the vertical disc diameter using the inner margin of the white Elschnig's ring as the reference. For quantification, a correction factor needs to be used depending on the magnification of the handheld lens; in clinical practice it is rarely used.

II.1.3.1.7 Rim width and cupping

The traditional use of cup/disc ratio (CDR) to classify patients is not recommended and the attention should be focused on the neuroretinal rim such as colour, rim width, intra and inter eye asymmetry and irregularity in distribution (Fig. II.1.14).

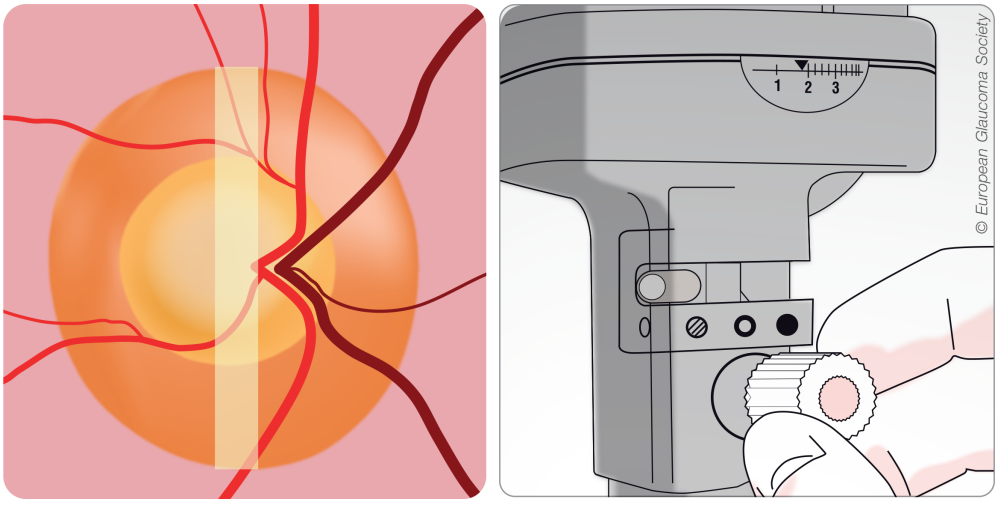


Figure II.1.13 *Direct clinical examination of the optic nerve head using a high power convex lens at the slit lamp.*

The Guidelines project was entirely supported by the European Glaucoma Society Foundation

Br J Ophthalmol: first published as 10.1136/bjophthalmol-2025-egsguidelines on 8 September 2025. Downloaded from http://bjo.bmj.com/ on September 29, 2025 by guest.
Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

II.1.3.2 Recording of the ONH and RNFL features

Some form of photography or imaging is recommended to provide a record of the ONH and RNFL appearance. Sequential photographs can be used to detect progression of optic disc and RNFL damage.

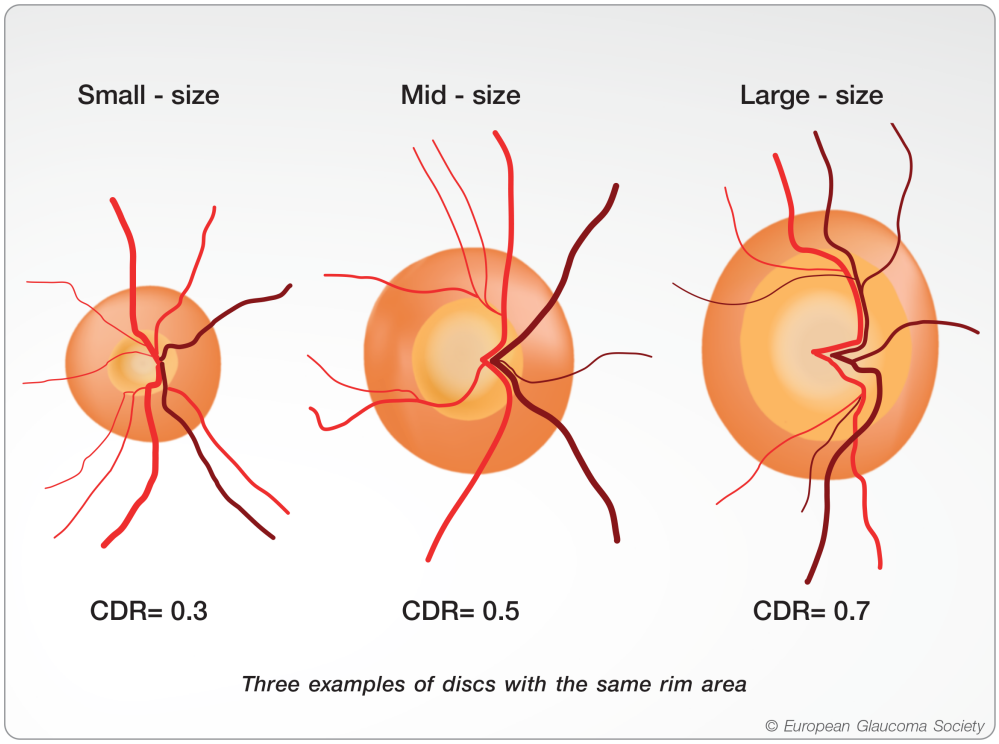


Figure II.1.14 *Optic nerve heads with different disc areas but with the same rim area and the same number of retinal nerve fibers. From left: small size disc (disc area less than 2 mm² and CDR=0.3), mid-size disc (disc area between 2 and 3 mm², CDR=0.5) and large disc (disc area more than 3 mm2 and CDR=0.7).*

The Guidelines project was entirely supported by the European Glaucoma Society Foundation

Br J Ophthalmol: first published as 10.1136/bjophthalmol-2025-egsguidelines on 8 September 2025. Downloaded from http://bjo.bmj.com/ on September 29, 2025 by guest. Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

II.1.3.2.1 Quantitative imaging-Optical Coherence Tomography (OCT)

Quantitative imaging of the ONH, retinal nerve fibre layer and inner macular layers using OCT are used widely to assist glaucoma diagnosis and to detect glaucomatous progression during follow-up. Neither fundus photography nor OCT should replace clinical examination and VF testing.

See details about OCT testing and interpretation in the EGS book "Glaucoma Imaging" (2024): *https://www.eugs.org/educational_materials/147*

OCT is based on short-coherence interferometry and is the most widely used test to document glaucomatous retinal and optic nerve head damage. Current instruments are spectral domain and swept-source OCT systems. Their technical, software and reference database characteristics vary also among manufacturers; therefore, values measured with different OCT devices are not interchangeable. Three main parameter groups are measured and analysed for classification and detection of progression: ONH, peripapillary retinal nerve fibre layer and macular inner retinal layers. Interpretation of apparent progression in OCT has to be done with caution due to the possible variability of the measurements, the effect of aging, and possible changes nonrelated to glaucoma. In cases of advanced loss, progression analysis may be beyond the dynamic range of the instrument.
OCT angiography is a rapidly evolving technology for visualizing the retinal and optic nerve head microvasculature. The role of which is not yet defined in glaucoma management.

II.1.3.2.2 OCT for glaucoma diagnosis

OCT imaging instruments typically provide three potential outcomes: 'within normal limits', 'borderline' and 'outside normal limits'. This represents a statistical result comparing the individuals' values with normative database of healthy eyes. OCT is a valuable diagnosis support system but does no replace clinical diagnosis. Therefore, an interpretation of the results in the context of all clinical data is mandatory. Imaging artefacts and software segmentation errors can occur and are more frequent in eyes that are highly myopic or have tilted discs. The clinician should carefully assess the quality of the image and segmentation analysis and judge whether the reference database is relevant for the particular patient.

When assessing for glaucomatous damage, clinicians should integrate data from the optic nerve head (ONH), peripapillary retinal nerve fiber layer (RNFL), and macular parameters (see programmes). Evaluation should include both quantitative thickness measurements and qualitative analysis of deviation maps to enhance diagnostic accuracy.
The various imaging technologies have their own advantages and limitations, and their classifications show only partial agreement with clinical exams in diagnosing glaucoma. Diagnosis of glaucoma based on results from one specific exam should be avoided.

The Guidelines project was entirely supported by the European Glaucoma Society Foundation

Br J Ophthalmol: first published as 10.1136/bjophthalmol-2025-egsguidelines on 8 September 2025. Downloaded from http://bjo.bmj.com/ on September 29, 2025 by guest.
Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

Hence, an OCT test "outside normal limits" may be a false positive and does not necessarily indicate that the subject has glaucoma.

II.1.3.2.3 Detection of progression with OCT

Most commercial imaging devices have software for quantifying glaucomatous progression, including the rate of progression. These results may serve as additional tools for the assessment of glaucomatous progression but need careful interpretation in conjunction with other tests. As with any other test high quality baseline images are particularly important. The user should assess the test series for the quality of images and software analysis before including the software output in the assessment of the patient.
Several studies have shown that agreement between structural progression and functional deterioration is only partial because of the measurement variability of both structural and functional tests. The structure–function relationship in glaucoma progression depends on disease stage: OCT detects change earlier in mild disease, shows a linear relationship with structural loss in moderate stages, and reaches a floor effect in advanced glaucoma, where functional tests better detect worsening
Most commercially available software for OCT follow-up analysis do not compensate for aging, therefore statistically significant slopes do not necessarily mean true glaucomatous progression. As mentioned above results acquired with different instruments are not interchangeable and cannot be used for longitudinal analysis.

II.1.3.2.4 Programmes

To assess retinal ganglion cells, three programs are used in clinically practice. OCT can quantify them in the ONH, around ONH in the peripapillary area and in the macula. Rim width is assessed in the ONH, RNFL in the peripapillary area and ganglion cell complex in the macula.
All parameters can be used to discriminate glaucomatous eyes in mild to moderate stages. OCT has relatively limited value in advanced disease because of a floor effect: under these circumstances it is clinically more useful to examine the GCC rather than the RNFL. Absolute values of the parameters are different from one OCT to another, thus using the same machine or system for follow up is recommended.

The Guidelines project was entirely supported by the European Glaucoma Society Foundation

Br J Ophthalmol: first published as 10.1136/bjophthalmol-2025-egsguidelines on 8 September 2025. Downloaded from http://bjo.bmj.com/ on September 29, 2025 by guest.
Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

Table II.1

Each system usually assesses the same parameters in a different way even if called by the same name or acronym.
Good quality of the OCT image is mandatory for clinical assessment.
Ganglion cell axons can be assessed: - In the scleral canal: Rim area - In the peripapillary area: RNFL - In the macula: GCC, GC-IPL, GCL
In advanced glaucoma, OCT analysis is not recommended because of a floor effect, which occurs later in time for macular parameters compared to RNFL thickness.This means that, at advanced stages, further disease progression is no longer reflected by continued thinning of these layers.

1) To assess ONH is mandatory in glaucoma patients
2) Disc area can vary substantially among individuals
3) Imaging can help to evaluate the loss of retinal ganglion cells and of the nerve fiber bundles

The Guidelines project was entirely supported by the European Glaucoma Society Foundation

Br J Ophthalmol: first published as 10.1136/bjophthalmol-2025-egsguidelines on 8 September 2025. Downloaded from http://bjo.bmj.com/ on September 29, 2025 by guest.
Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

II.1.4 Perimetry

II.1.4.1 Perimetry techniques

Visual field (VF) testing plays a central role in the diagnosis and in the management of glaucoma. Loss of visual function is associated with loss of quality of life, and it is therefore necessary to monitor each glaucoma patient's VF status.
Static computerised perimetry is preferred in glaucoma management. Kinetic, e.g. Goldmann perimetry, is not suitable for detection of early glaucomatous field loss, since small defects can often be missed between isopters. Computerised perimetry is also less subjective since the results are numerical and tools for computer-assisted interpretation are available. Manual kinetic perimetry may be useful in end-stage disease and in the patients unable to perform automated perimetry.

II.1.4.1.1 Automated threshold perimetry

The term Standard Automated Perimetry (SAP) refers to static computerised threshold perimetry performed using standard Goldmann white stimuli on a white background and is the recommended technique in glaucoma management.

Testing algorithms and programs
Various perimeters attempt to estimate perimetric threshold sensitivity using different testing algorithms and patterns. Frequently used threshold algorithms in the Humphrey Visual Field Analyzer (Zeiss Meditec, Dublin, CA, USA), which is the most used perimeter, are Swedish interactive threshold algorithm (SITA) Standard, SITA Fast and SITA Faster. In the Octopus perimeter (Haag-Streit AG, Köniz, Switzerland) the Dynamic Strategy is often recommended for glaucoma diagnosis and follow up. The Octopus TOP algorithm (tendency-oriented perimetry) differs considerably from the SITA and Dynamic strategies. In glaucoma patients and glaucoma suspects, perimetry is usually performed using a Goldmann size III stimulus in the central 24° or 30° field, where the great majority of retinal ganglion cells are located. The VF outside 30° is seldom tested. In recent years it has sometimes been recommended to perform additional testing focusing on the central 10° of the field, in order to detect more central field loss. EGS does not recommend decreasing the frequency of standard 24° or 30° testing by replacing these tests with 10° tests. Such additional testing may be reserved for eyes where structure/function findings do not agree, e.g., in eyes with normal central 24° or 30° VFs but pathological or suspect optic nerve or RNFL findings. Central field loss is very common in glaucoma and such loss at very central points, often referred to as 'threat to fixation' is clinically worrisome since central VF defects can be symptomatic and compromise the ability to drive. Macular-enriched grids such as the Humphrey 24-2C have been developed to improve detection of central damage while still covering the peripheral field; although they may offer a useful compromise, current support in the literature remains limited.
As far as possible, it is advantageous to follow patients using a consistent test pattern and strategy, as well as the same technology in order to facilitate detection

The Guidelines project was entirely supported by the European Glaucoma Society Foundation

Br J Ophthalmol: first published as 10.1136/bjophthalmol-2025-egsguidelines on 8 September 2025. Downloaded from http://bjo.bmj.com/ on September 29, 2025 by guest.
Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

and quantification of change. In eyes with advanced VF loss, it may be advantageous to switch to a larger stimulus size, e.g. to a Goldmann size V stimulus rather than size III, or to a test point pattern which focuses more closely on the remaining area of functioning vision. In most perimeters one may use test point patterns examining only the central 10° of the field in eyes which have severe loss of paracentral and peripheral function or only 'tunnel' fields left.

II.1.4.1.2 Non-conventional perimetry

Some modalities of computerised perimetry use testing stimuli that differ from those used in SAP. Examples include SWAP, frequency doubling technology (FDT), and flicker perimetry. These techniques were developed with the hope that they would be able to recognise glaucomatous field loss earlier than conventional SAP but, since such evidence is lacking, they are not recommended for glaucoma management.

II.1.4.1.3 Patient instructions

The role of the perimetric technician is of greatest importance in patients who are new to automated perimetric testing. Perimetrically inexperienced patients will produce more reliable test results if the operator simply explains what to expect and how to respond to stimuli. It is, however, very important to point out to perimetric novices, before the first few tests, that many stimuli will be very dim and difficult to see and that even subjects with normal VFs will not see all the stimuli. Without such instructions and explanations many patients will experience perimetry negatively. A demonstration lasting just a few seconds, in which the naïve patient sees what the stimuli look like, where they will appear and how they change brightness will help the patient understand the test, and will reduce patient anxiety, thus making patients more willing to return for future perimetric testing. Most experienced patients require only minimal re-instruction. However, even with experienced patients, the operator should remain in the vicinity of the perimeter in order to hear and respond to any patient queries. A quiet, dimly lit environment is necessary. All personnel performing visual fields should have taken enough threshold perimetry tests themselves to understand first-hand what it is like being tested.

The learning effect
Many subjects show an improvement in performance reflected as improved reliability and sensitivity over the first few tests.

II.1.4.2 Interpreting test results

Most perimeters provide test results and analyses in paper or electronic reports containing different maps of the VF plus summary indices and other interpretations.

The Guidelines project was entirely supported by the European Glaucoma Society Foundation

Br J Ophthalmol: first published as 10.1136/bjophthalmol-2025-egsguidelines on 8 September 2025. Downloaded from http://bjo.bmj.com/ on September 29, 2025 by guest.
Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

II.1.4.2.1 Test data elements commonly seen in perimetry reports

- The numerical threshold map provides the 'raw' estimated threshold values at each test point location.
- The grey scale maps provide a graphical representation of the numerical threshold map, while in the Octopus perimeter the colour-coded maps provide a graphical representation of the deviations from age-corrected normal values.
- The numerical total deviation map shows point-wise differences between the age-corrected normal threshold sensitivity at each test point location and the patient's measured threshold value.
- The numerical pattern deviation map and the corrected deviation map show the same values but after correction for any diffuse loss of sensitivity. Thus, both types of deviation maps highlight localised field loss.
- Probability maps are very important, since they provide the statistical significance of the numerical deviations, compared to age corrected normative data.

II.1.4.2.2 Reliability indices

These indices are meant to estimate the reliability of test results and were developed in the early days of automated perimetry. Over time it has become clear that these indices are themselves not very reliable. Thus, high frequencies of false negative (FN) responses have been shown to be of relatively little value in the evaluation of glaucomatous VFs, since abnormal fields often have high FN values even in patients who are very attentive and responsive. The impact of FNs varies with disease severity. While FNs hold little value in patients with moderate to severe disease, they may provide useful information in cases of suspected glaucoma or early-stage disease. High rates of fixation losses (FL) assessed using the blind spot technique may indicate poor fixation, but if the blind spot position is erroneously located, a high FL rate will be indicated even if fixation is perfect. It is probably better to rely on the automatic eye/ gaze tracker of the perimeter or on the judgement of the perimetrist. FLs have limited effect on test-retest variability, so a test with high FLs should not always be considered as unreliable. High frequencies of false positive (FP) answers, may be a sign of poor reliability, but many tests with relatively high FP rates have been found to provide useful information. Most patients will deliver very useful perimetry test results if properly instructed, and exams should not be discarded only because one or more reliability parameters has been flagged by the instrument's software.

II.1.4.2.3 Visual field indices

VF indices are numbers summarising perimetric test results. MD (mean deviation in the Humphrey or mean defect in the Octopus) is indicative of the average difference between age-corrected normal sensitivity and measured threshold sensitivity values at all test point locations. The visual field index (VFI - Humphrey) is similar to the MD but more heavily centre-weighted. VFI results are expressed in percent rather than in decibels and are more resistant to cataract effects, compared to MD. The Humphrey

The Guidelines project was entirely supported by the European Glaucoma Society Foundation

Br J Ophthalmol: first published as 10.1136/bjophthalmol-2025-egsguidelines on 8 September 2025. Downloaded from http://bjo.bmj.com/ on September 29, 2025 by guest. Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

PSD and the Octopus loss variance (LV) index are designed to detect localised loss. In general, global indices are not primarily meant for and should not be used alone for diagnosis.

II.1.4.2.4 Interpretation methods and aids

A first-time normal exam can be accepted if reliable, but a first-time apparently abnormal exam should be repeated and confirmed if not consistent with other clinical findings i.e., with the appearance of the optic nerve and RNFL.

Analysis of single field test results, based on clustered points
Clusters of test point locations with significantly reduced sensitivity are more reliable indicators of early glaucomatous field loss than are an equal number of significantly depressed points that are randomly scattered about the VF. One rule which is often used to classify a test result as outside normal limits requires a minimum of three clustered points having significantly depressed sensitivity, among which at least one should have a significance of $p<1\%$.

The Bebié curve
The Bebié curve, which is also known as the cumulative defect curve of the Octopus perimeter, is a summary graph of localised and diffuse sensitivity loss. In entirely diffuse loss the overall curve shows reduced sensitivity compared to normal. This is typically associated with media opacities and not with glaucoma. In focal loss, the right part of the curve is depressed as compared to the normal reference curve. Focal loss is much more consistent with a diagnosis of glaucoma than is diffuse loss.

The Glaucoma Hemifield Test (GHT)
The Glaucoma Hemifield Test of the Humphrey perimeter was developed specifically to examine clusters of points relevant to glaucoma. It classifies results as 'within normal limits', 'outside normal limits' or 'borderline'. Other GHT classifications are 'general depression of sensitivity', typically found in eyes with media opacities but no manifest glaucoma, and 'abnormally high sensitivity' which indicates that the patient has pressed the response button even when non-perceptible stimuli were presented. Importantly, the GHT primarily detects abnormalities based on asymmetry between the superior and inferior hemifields; as such, symmetric arcuate defects which are not uncommon in glaucoma may still produce a result 'within normal limits'.

II.1.4.2.5 Confirmation of classification

Field defects which appear clearly glaucomatous, and which are consistent with other clinical findings usually do not need confirmation to support a diagnosis. VFs with subtle defects may require confirmatory tests (See Fc VI).

The Guidelines project was entirely supported by the European Glaucoma Society Foundation

Br J Ophthalmol: first published as 10.1136/bjophthalmol-2025-egsguidelines on 8 September 2025. Downloaded from http://bjo.bmj.com/ on September 29, 2025 by guest.
Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

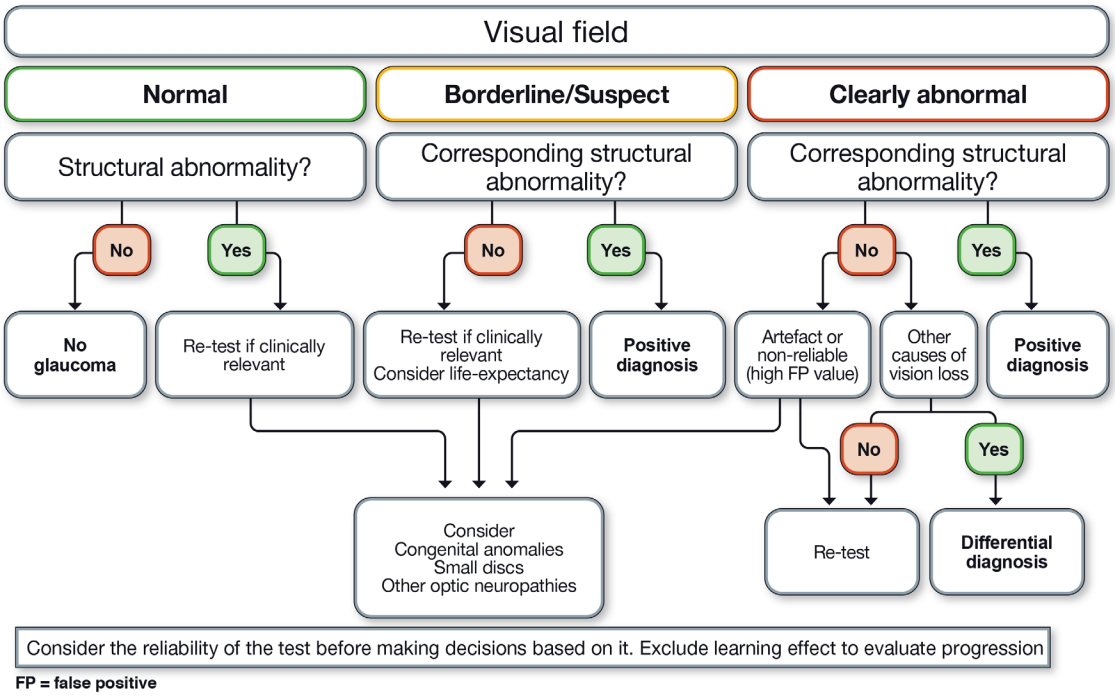
II.1.4.2.6 Detecting and quantifying glaucomatous visual field deterioration

It is important to detect and also to quantify VF deterioration in patients under care for glaucoma (see Fc VII). Be aware that progression software may automatically exclude tests flagged as unreliable, even though such tests can still provide clinically valuable information. There are two main approaches to computer-assisted VF progression analyses:

Event analyses

Progression event analyses seek to detect whether or not a statistically significant VF change has occurred. Indices or test points/clusters are flagged if they have deteriorated more than the expected test-retest variation. Event based analyses have been used in large randomised controlled glaucoma trials, e.g. EMGT, AGIS, CIGTS and UKGTS (See Ch I.1.7). In clinical practice, event analysis is complementary to trend analyses, especially for detecting focal damage. Event analyses usually require confirmation testing.

FC VI Interpretation initial visual field test



FP = false positive

© European Glaucoma Society

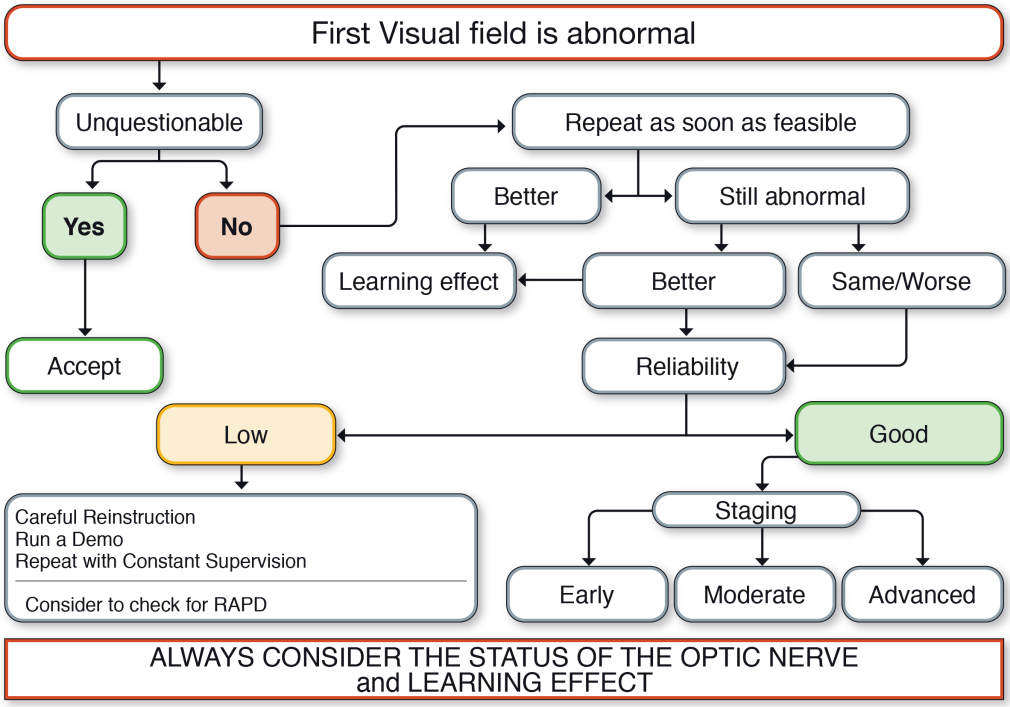
The Guidelines project was entirely supported by the European Glaucoma Society Foundation

Br J Ophthalmol: first published as 10.1136/bjophthalmol-2025-egsguidelines on 8 September 2025. Downloaded from http://bjo.bmj.com/ on September 29, 2025 by guest. Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

Trend analyses

Regression analysis to determine the VF rate of progression is widely accepted and is strongly recommended in the management of eyes having glaucomatous field loss. The perimetric rate of progression is the velocity of worsening of the VF and is usually quantified by using linear regression analysis over time of the global indices MD or VFI. Rate of progression is expressed in dB/year or in %/year. Plotting the MD or VFI value of an eye over time can show if the observed rate of progression is likely to lead to loss of QoL during the patient's expected life-time. PSD and LV should not be used for trend analysis, because in early disease they increase as the field worsens but then peak and start decreasing again as VF damage becomes moderate to advanced. Trend based analysis in the form of pointwise linear regression has been used in large scale studies such as the LoGTS RCT and a landmark cohort study relating optic disc haemorrhage to VF progression (See Ch I.1.7).

FC VII Diagnostic strategy when initial visual field is abnormal



RAPD = relative afferent pupillary defect

© European Glaucoma Society

The Guidelines project was entirely supported by the European Glaucoma Society Foundation

Br J Ophthalmol: first published as 10.1136/bjophthalmol-2025-egsguidelines on 8 September 2025. Downloaded from http://bjo.bmj.com/ on September 29, 2025 by guest.
Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

Number and frequency of tests

Determining the rate of progression of an individual eye usually requires a significant time span, typically at least two years, and enough field tests. It has been proposed that newly diagnosed glaucoma patients should be tested with SAP three times per year during the first two years after diagnosis. In this way rate of progression can be determined early, and rapidly progressing eyes can be revealed with great certainty. Most often, the frequency of testing can then be reduced and tailored to the observed progression rate, and to the stage of disease. Patients with OHT do not need frequent VF testing; once every one or two years is often sufficient.

II.1.4.2.7 Other perimeters

It should be noted that, although this Chapter has focused on two perimeter brands, the Octopus and the Humphrey, alternative devices by several different manufacturers are available and more are under development.

Several promising technologies for home-based perimetry have been identified. However, current studies have primarily been conducted in controlled settings with highly selective populations. The effectiveness and value of home-based perimetry for glaucoma remain uncertain. Further research is needed to determine its capability in detecting glaucoma and monitoring disease progression under real-world conditions.

Systematic reviews:

- Daka Q, Mustafa R, Neziri B, Virgili G, Azuara-Blanco A. Home-Based Perimetry for Glaucoma: Where Are We Now? J Glaucoma. 2022 Jun 1;31(6):361-374. doi: 10.1097/IJG.0000000000002022. Epub 2022 Mar 25. PMID: 35394454..

II.1.4.2.8 Staging of visual field defects

Table II.2 Staging of severity of disease with visual fields. dB: decibels.

Stage of Visual Field Loss		
System	**Humphrey Octopus** MD: mean defect	**Octopus** MD: mean deviation
Early	MD ≤ 6 dB	MD ≤ 4.5 dB
Moderate	6 > MD ≤ 12 dB	4.5 > MD ≤ 9.5 dB
Advanced	MD > 12 dB	MD > 9.5 dB

Glaucoma staging is based on the severity of VF damage. Several staging systems have been developed. A simple system based on MD alone is acceptable (see above, simplified from Hodapp's and Mills' classification). Worse MD values are associated with higher risk of blindness.

The Guidelines project was entirely supported by the European Glaucoma Society Foundation

Br J Ophthalmol: first published as 10.1136/bjophthalmol-2025-egsguidelines on 8 September 2025. Downloaded from http://bjo.bmj.com/ on September 29, 2025 by guest. Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

II.1.5 Artificial intelligence

Artificial Intelligence (AI) is revolutionising healthcare. AI applications in glaucoma use clinical data, fundus photography, OCT, and VF data to diagnose the disease, monitor its progression, and predict future developments. Studies have shown a high accuracy of AI algorithms in diagnosing glaucoma and detecting its progression. Additionally, AI tools may be useful for patient risk profiling. However, several challenges must be addressed before widespread clinical adoption.

II.1.5.1 Key challenges

- **Model Generalisability:** AI models may lack the ability to generalise across different populations and clinical settings due to limited and non-representative training data.
- **Data Quality:** AI performance heavily depends on data quality.
- **Data Quantity:** AI models, particularly deep learning (DL), require vast amounts of data. In glaucoma, large-scale, standardised datasets are scarce, limiting model robustness.
- **Difficulties assessing ground truth:** establishing a reliable ground truth, as clinical diagnosis often involves subjective interpretation of imaging and functional tests, leading to variability even among expert clinicians.
- **Model Interpretability (Black-Box Issue):** Many AI models operate as black boxes, making it difficult for clinicians to understand their decision-making processes, reducing trust.
- **Data Ownership and Privacy:** Data-sharing across institutions raises concerns over ownership and privacy, complicating efforts to create large, centralised datasets.
- **Poor uncertainty estimations.**
- **Cost and Accessibility:** AI tools are not yet available for everyday clinical settings and future costs are uncertain.

II.1.5.2 Solutions and future directions

- **Federated Learning:** Federated learning enables external access for the training of AI models on data that does not leave the health institution. Model updates are combined centrally, maintaining data privacy while creating robust AI models across multiple institutions. This solves concerns about data ownership and privacy.
- **Generative AI for Data Scarcity:** Generative AI models like Generative Adversarial Networks can generate synthetic medical images, which are virtually indistinguishable from real ones and help address data scarcity while preserving patient privacy.
- **Improving Interpretability:** New techniques like saliency/heat maps, attention mechanisms, and Vision Transformers help make AI models more transparent, allowing clinicians to see how models generate their predictions.
- **International Collaboration:** Pooling data through international collaborations can enhance data diversity and quantity, improving model generalisability and robustness.
- **Multimodal Models:** Combining data from various sources (OCT, VFs, fundus photography) can create more accurate models that offer comprehensive insights into glaucoma diagnosis and progression.

The Guidelines project was entirely supported by the European Glaucoma Society Foundation

Br J Ophthalmol: first published as 10.1136/bjophthalmol-2025-egsguidelines on 8 September 2025. Downloaded from http://bjo.bmj.com/ on September 29, 2025 by guest. Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

- **Regulations for Data Security:** New regulations are needed to protect not only personal data but also the integrity of AI models, ensuring secure and ethical deployment in clinical practice.
- **Screening cost-effectiveness:** AI-based diagnostic screening tools and risk profiling may allow screening to become more cost-effective.

AI is transforming glaucoma care: High accuracy in diagnosis, progression monitoring, and risk profiling.
At present, there is **not enough evidence to support AI algorithms in clinical practice.**
Key Challenges: Generalisability, data quality & quantity, black-box models, privacy concerns, and accessibility.
Future Solutions: Federated learning, generative AI, multimodal models, improved interpretability, global collaboration, and data security regulations.

Systematic reviews:

- Buisson M, Navel V, Labbé A, Watson SL, Baker JS, Murtagh P, Chiambaretta F, Dutheil F. Deep learning versus ophthalmologists for screening for glaucoma on fundus examination: A systematic review and meta-analysis. Clin Exp Ophthalmol. 2021 Dec;49(9):1027-1038. doi: 10.1111/ ceo.14000. Epub 2021 Sep 22. PMID: 34506041.
- Wu JH, Nishida T, Weinreb RN, Lin JW. Performances of Machine Learning in Detecting Glaucoma Using Fundus and Retinal Optical Coherence Tomography Images: A Meta-Analysis. Am J Ophthalmol. 2022 May;237:1-12. doi: 10.1016/j.ajo.2021.12.008. Epub 2021 Dec 21. PMID: 34942113.
- Chaurasia AK, Greatbatch CJ, Hewitt AW. Diagnostic Accuracy of Artificial Intelligence in Glaucoma Screening and Clinical Practice. J Glaucoma. 2022 May 1;31(5):285-299. doi: 10.1097/ IJG.0000000000002015. Epub 2022 Mar 18. PMID: 35302538.

The Guidelines project was entirely supported by the European Glaucoma Society Foundation

Br J Ophthalmol: first published as 10.1136/bjophthalmol-2025-egsguidelines on 8 September 2025. Downloaded from http://bjo.bmj.com/ on September 29, 2025 by guest.
Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

II.1.6 Genetics

Many forms of congenital and juvenile glaucoma are linked to specific genetic mutations, but management of these conditions is based on the phenotype, i.e. the clinical presentation. The remainder of this section deals with genetic influences on POAG, since this is responsible for the greatest burden of disease of the glaucomas. The search for the genetic basis of POAG was prompted by epidemiological findings, for example that first degree relatives of glaucoma patients are at considerably higher risk of developing the condition. The areas of the genome associated with POAG can be divided into Mendelian mutations and complex variants.

II.1.6.1 Mendelian mutations

Mendelian diseases are usually caused by single genetic defects which are rare and strongly linked to the development of disease. Environmental factors and variants elsewhere in the genome apart from the causative mutation do not affect the presence or absence of disease. The most common Mendelian forms of POAG are caused by mutations in the myocilin (MYOC) gene. The prevalence of MYOC mutations has been estimated as 2-4% in POAG patients, but if patients are preferentially selected based on young age of onset, high IOP and strong family history the prevalence rises to 16-40%. As an example, a young, currently unaffected member of a family which carries a MYOC mutation may benefit from genetic testing to discover whether she/he has the mutation. If negative for MYOC this subject has no excess risk for POAG; if posititve close monitoring and early treatment may be useful to prevent future vision loss. However, the advisability of genetic testing will depend on a number of factors such as details about the condition and its prognosis, the inheritance pattern, and the risk to children or other family members. Counselling for at-risk but currently unaffected family members should explore the underlying motivation for genetic testing and explain the testing process and the potential impact of the test result.

Individuals from families with multiple members affected with POAG at a relatively young age should be offered the opportunity to undergo genetic testing for MYOC mutations. The discussion and eventual decision should be in liaison with a clinical genetics counselling service.

The Guidelines project was entirely supported by the European Glaucoma Society Foundation

Br J Ophthalmol: first published as 10.1136/bjophthalmol-2025-egsguidelines on 8 September 2025. Downloaded from http://bjo.bmj.com/ on September 29, 2025 by guest.
Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

II.1.6.2 Complex variants

In contrast to Mendelian mutations, variants which contribute to complex disease occur in numerous genes, are more common and have a relatively small effect size. The conceptual framework posits that multiple genetic variants, in conjunction with environmental factors, interact to contribute to disease development. With the advent of genome-wide association studies hundreds of such variants associated with POAG, IOP and disc morphology have been discovered. Variants associated with IOP have been incorporated into a genetic prediction model for POAG and a variant in the TMCO1 gene has been incorporated into the risk calculator for conversion from ocular hypertension to POAG in the Ocular Hypertension Treatment Study (OHTS). Though the contribution of complex variants to the diagnosis and management of POAG is constantly and rapidly improving it is currently not appropriate to use these variants as a basis for genetic screening.

Do not offer genotyping routinely to adult glaucoma patients.

II.1.6.3 Third party genotyping

Individuals may present to healthcare services seeking advice about the results of their genotypes which have been obtained from direct-to-consumer private companies or as a result of volunteering for research studies. Such genetic information is usually not subject to the same quality control measures as in clinical genetics services so the results may be misleading. For example, the false positive rate for some BRCA gene variants in the UK Biobank was more than 84%. Thus, third party genotyping measures should not currently be used for clinical decision making.
Polygenic Risk Scores (PRS) estimate the combined effect of many genetic variants on an individual's relative risk of disease. They have also been used in glaucoma to predict progression and response to treatment. This approach holds hope for the future but currently no PRS has been validated for clinical use.

Genetic information obtained by third party commercial services should be considered with regard to the accuracy and reliability of the providing service, and any decison making resulting from it must be integrated into the clinical context of the specific patient.

The Guidelines project was entirely supported by the European Glaucoma Society Foundation

Br J Ophthalmol: first published as 10.1136/bjophthalmol-2025-egsguidelines on 8 September 2025. Downloaded from http://bjo.bmj.com/ on September 29, 2025 by guest.
Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

Br J Ophthalmol: first published as 10.1136/bjophthalmol-2025-egsguidelines on 8 September 2025. Downloaded from http://bjo.bmj.com/ on September 29, 2025 by guest.
Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

Part II · Chapter 2

Classification and terminology

Br J Ophthalmol: first published as 10.1136/bjophthalmol-2025-egsguidelines on 8 September 2025. Downloaded from http://bjo.bmj.com/ on September 29, 2025 by guest.
Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

Br J Ophthalmol: first published as 10.1136/bjophthalmol-2025-egsguidelines on 8 September 2025. Downloaded from http://bjo.bmj.com/ on September 29, 2025 by guest.
Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

The Guidelines project was entirely supported by the European Glaucoma Society Foundation

II.2 Classification and terminology

II.2.1 Childhood glaucoma

Childhood glaucoma is a group of challenging diseases because of its rare occurrence, heterogeneous phenotype and its various underlying conditions. Examination can be difficult due to low cooperation. An immediate therapy performed by a well-coordinated interdisciplinary team of an experienced glaucoma surgeon, paediatric ophthalmologists, pediatricians and anaesthetists is necessary to prevent blindness. Nevertheless, most children will suffer a significant impairment of vision and quality of life. Surgical treatment is necessary in nearly all cases. See below and Ch II.3.14.2.

II.2.1.1 Classification

Childhood glaucoma is classified into primary and secondary types following the Childhood Glaucoma Research Network (CGRN-ChildhoodGlaucoma.com) (see table II.3).

Caveat: The current age-based classification does not take into account the genetic background. This classification rather reflects the prognosis than the pathophysiology.

Table II.3

Childhood Glaucoma Classification adapted from CGRN*	
1. Primary Childhood glaucoma	
1.1. Primary Congenital Glaucoma (PCG)	
• Neonatal or newborn onset • Infantile onset • Late onset or lately recognised • Self healed PCG	0-1 month >1 until 24 months >2 years Spontaneously non-progressing cases with normal IOP but typical signs of PCG
1.2. Juvenile Open Angle Glaucoma (JOAG)	Age > 4 years
2. Secondary Open Angle Childhood glaucoma (SCG)	
2.1. SCG associated with acquired ocular conditions 2.1. SCG associated with non-acquired ocular anomalies 2.1. SCG associated with non-acquired systemic disease or syndrome 2.1. SCG following cataract surgery	
*http://www.childhoodglaucoma.com/_files/ugd/fdfc49_145b1c5500c5411c9854c68d084f39f9.pdf	

The Guidelines project was entirely supported by the European Glaucoma Society Foundation

Br J Ophthalmol: first published as 10.1136/bjophthalmol-2025-egsguidelines on 8 September 2025. Downloaded from http://bjo.bmj.com/ on September 29, 2025 by guest.
Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

II.2.1.2 Primary Congenital Glaucoma (PCG)

Epidemiology:
Congenital glaucoma occurs in about 1 in 12-18,000 births among white Europeans. Incidence can be 5 to 10 times higher if consanguinity of parents is present. Severe visual disability is common. PCG is more common in males (65%), and is bilateral in 70% of patients. Isolated angle dysgenesis or dysgenesis involving the trabecular meshwork (trabeculodysgenesis) is the most common form of primary congenital glaucoma.

Aetiology/mechanism:
Angle dysgenesis is caused by incomplete development of the TM/outflow system before and/or after birth. There is a primarily monogenic influence, however, polygenic patterns are a current subject of research. Heredity shows recessive inheritance with variable penetrance in most cases or is sporadic. The most common associated gene is CYP1B1, others are TEK/ANGPT1, LTBP2, MYOC and EFEMP1. Genetic testing is recommended to rule out other congenital abnormalities, to facilitate consultation in regard of family planning of both patients and parents and to help coping and disease management. Consanguinity increases the risk of the disease severity and is considered as a poor prognostic factor.
Decreased aqueous outflow due to trabeculodysgenesis causes significant elevation of IOP. High IOP may lead to buphthalmos and to optic neuropathy.

Symptoms and findings (see Table II.4):
- Not always symptomatic
- Photophobia, tearing, blepharospasm, and eye rubbing are typical early signs
- Crying, unhappy child during first weeks or year of life may raise suspicion
- Large eyes/buphthalmos with large corneal diameters and Haab striae
- Disc cupping typically occurs only after some months and may reverse following successful treatment
- Gonioscopic signs: anterior insertion of the iris, forming a scalloped line with persistent uveal tissue and poorly differentiated structures as a sign of trabeculodysgenesis

Certain diagnostic criteria likely carry more weight than others e.g. Haab striae, axial length. The diagnostic value of IOP alone is insufficient to make a diagnosis of PCG because IOP in children underlies substantial fluctuations depending on the setting and on the child. Threshold for normal IOP is not comparable to adults. Usually, the best values are taken in the cooperative, calm and awake child using hand-held tonometers, however, the choice of measurement method is at the discretion of the investigator. A measurement taken in a crying awake child can cause falsely high values, on the other hand, most anaesthetics cause falsely low values. Besides applanation tonometry, rebound tonometry is a valid option in childhood glaucoma and can also be used for home tonometry. Haab striae are a strong indicator for congenital glaucoma. Corneal diameter should be monitored over time. If it exceeds the age-related normal growth it can be a sign of uncontrolled IOP. Central corneal thickness should also be measured as it can be increased also without corneal oedema and possibly influences the IOP

The Guidelines project was entirely supported by the European Glaucoma Society Foundation

Br J Ophthalmol: first published as 10.1136/bjophthalmol-2025-egsguidelines on 8 September 2025. Downloaded from http://bjo.bmj.com/ on September 29, 2025 by guest.
Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

Table II.4 Diagnostic criteria of PCG (according to CGRN*)

To establish the **diagnosis of PCG**, 2 of the 5 criteria need to be met:
- IOP > 21 mmHg
- Corneal findings:
  - Haab striae (ruptures of Descemet's membrane)
  - Corneal epithelial (sometimes stromal) oedema
  - Megalocornea (diameter ≥ 11mm in newborn; diameter > 12mm during the first year of life; diameter > 13mm regardless of age)
- Optic disc cupping:
  - Progressing diffuse reduction of neuroretinal rim
  - Cup-to-disc ratio (CDR) asymmetry ≥ 0.2 between right and left eye with similar optic disc size
  - Notch
- Progressing myopia or myopic shift with age-inappropriate increase of axial length
- Corresponding and reproducible glaucomatous visual field defect without other reason for visual field defect

Glaucoma suspects are defined by one of the following criteria:
- IOP < 21 mmHg at two different occasions
- Glaucoma-suspect optic disc (e.g., large CDR or asymmetric CDR)
- Glaucoma-suspect visual field examination
- Large corneal diameters or axial length along with normal IOP

*http://www.childhoodglaucoma.com/_files/ugd/fdfc49_145b1c5500c5411c9854c68d084f39f9.pdf

values. Epithelial corneal oedema, while leading to underestimation of IOP, is a sign of increased IOP. Corneal pathologies that lead to increased corneal rigidity may overestimate IOP. Digital IOP evaluation (palpation) may be an alternative to estimate IOP.
Axial length is an important value for establishing the diagnosis. It is important for monitoring, as it can give information about the IOP during a given time interval.

Differential diagnoses:
- Conjunctivitis
- Nasolacrimal duct obstruction
- Posterior polymorphous corneal dystrophy (PPMD)
- Corneal hereditary endothelial dystrophy (CHED)
- X-linked megalocornea
- Birth trauma
- Ocular hypertension
- Large optic discs

The Guidelines project was entirely supported by the European Glaucoma Society Foundation

Br J Ophthalmol: first published as 10.1136/bjophthalmol-2025-egsguidelines on 8 September 2025. Downloaded from http://bjo.bmj.com/ on September 29, 2025 by guest.
Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

Don´t make decisions based on IOP alone, but look for structural changes of the cornea such as Haab striae, epithelial oedema, corneal enlargement.
Measuring of axial length is crucial for detecting and monitoring of the disease.
Consider the high risk of secondary glaucoma in early congenital cataract surgery.

Treatment:
Management of these cases is particularly challenging.
Initial surgery is indicated in nearly all cases with primary congenital glaucoma. Medical treatment is usually neither effective nor practicable in long term. Medications, including oral CAIs can be used while decision is made on a surgical approach and in case of failed surgery while preparing for further options.
Primary surgery: Angle surgery such as early ab interno or ab externo, in case of unclear cornea, trabeculotomy or goniotomy are the recommended first choice procedures. Subsequent filtration surgery or glaucoma drainage devices may be indicated if these are unsuccessful. Combined trabeculotomy/trabeculectomy may be considered in some cases. Cycloablative procedures can be used as interim solution to postpone revision surgery. Other surgeries are usually not recommended for childhood glaucoma.
Life-long follow-up of IOP is mandatory to avoid undetected progression. Orthoptic follow-ups as well as refractive correction are necessary to favor age-appropriate visual development, as **anisometropic amblyopia remains a significant cause of visual morbidity even after adequate intraocular pressure (IOP) control.**

In children, medical treatment can cause several side effects and needs to be applied with caution:

- Alpha-2-agonists: absolute contraindication age <2 years, relative contraindication age <7 years/body weight <20 kg as well as impaired blood-brain barrier (e.g., in children with Sturge Weber-syndrome and leptomeningeal angiomatosis). Narcolepsy is a side effect in any low body weight individual.
- Beta blockers: contraindicated especially in preterm and neonates. Possible bradycardia, respiratory depression, monitoring is to be considered, as well as starting with low concentration (0.1% or 0.25%).
- Carbonic anhydrase inhibitors (local/systemic): metabolic acidosis leading to failure to thrive, lethargy, lack of appetite, diarrhoea; not approved for preterm infants born before 36th week and newborns younger than 1 week; oral acetazolamide dose 10 to 15 mg/kg body weight per day, split in 2 to 3 doses (max. daily dose 20mg/kg body weight per day), can be given orally also dissolved in milk (e.g. 50mg/ml).
- Miotics: pylorospasm with consecutive vomiting possible, not advised in children aged <1 month.
- Prostaglandins: Travoprost is approved from the age of 2 months; Latanoprost not approved for preterm infants born befoore 36th week.

The Guidelines project was entirely supported by the European Glaucoma Society Foundation

Br J Ophthalmol: first published as 10.1136/bjophthalmol-2025-egsguidelines on 8 September 2025. Downloaded from http://bjo.bmj.com/ on September 29, 2025 by guest.
Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

Systematic review:
- Gagrani M, Garg I, Ghate D. Surgical interventions for primary congenital glaucoma. Cochrane Database of Systematic Reviews 2020, Issue 8. Art. No.: CD008213. DOI: 10.1002/14651858. CD008213.pub3.

II.2.1.3 Juvenile Open Angle Glaucoma (JOAG)

Aetiology/mechanism: Estimated prevalence: 1:50.000. Typically manifests between the age of 4 and 35 years. Often includes a variable dysgenesis resembling that of primary congenital glaucoma. Commonly associated with myopia. Inheritance patterns are heterogeneous, with MYOC and CYP1B being the most frequent genetic alterations.

Differentiation from PCG:
- No ocular or corneal enlargement
- No congenital ocular anomalies or syndromes
- May be asymptomatic until visual field loss advanced
- Frequently asymmetric findings

Features:
- Open angle
- Elevated IOP
- Might exhibit high iris insertion or iris processes on gonioscopy
- Optic nerve and VF damage depending on disease stage

Treatment:
Medical treatment is more successful than in PCG, however, surgery is frequently necessary (40-70%). Angle surgery (trabeculotomy, goniotomy) or combined angle and filtration surgery can yield good results. Filtering surgeries carry risk of hypotony which is higher in younger patients. Glaucoma drainage implants are an opportunity in refractory cases.

> The treatment of **childhood glaucoma** is particularly challenging due to the complex nature of the disease and to the intrinsic difficulties in examining patients at this age and operating on them. Treatment has to be adapted to the primary anomaly, and the mechanism of IOP elevation. Medications may be initiated as a temporary measure especially in PCG. It is recommended that these children should be referred to tertiary care centres with specific expertise. See I.5.4

II.2.1.4 Secondary Childhood Glaucoma

A variety of pathogenetic mechanisms are possible. A complete list and extensive discussion are outside the scope of the Guidelines.
Genetic testing is strongly recommended due to the large overlap of phenotypes.

The Guidelines project was entirely supported by the European Glaucoma Society Foundation

Br J Ophthalmol: first published as 10.1136/bjophthalmol-2025-egsguidelines on 8 September 2025. Downloaded from http://bjo.bmj.com/ on September 29, 2025 by guest.
Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

Treatment of secondary childhood glaucoma See Treatment for PCG (II.2.1.2). Secondary childhood glaucoma can be caused by both open angle and angle closure mechanisms. Management to be adapted to the primary anomaly, the mechanism of IOP elevation and the QoL of the patient. These patients require highly specialised care.

II.2.1.4.1 Glaucoma associated with non-acquired ocular anomalies

- Axenfeld Rieger anomaly (Syndrome if systemic associations)
- Peters anomaly (Peters Plus Syndrome if systemic associations)
- Aniridia
- Ectropion uveae
- Persistent foetal vasculature (if glaucoma present before cataract surgery)
- Oculodermal melanocytosis (Naevus of Ota)
- Posterior polymorphous dystrophy
- Microphthalmos
- Microcornea
- Ectopia lentis
- Nanophthalmos

Heredity: Heterogeneous phenotypes with fluent transitions between anterior segment syndromes are possible. Genetic testing may help to differentiate between the syndromes. However, also the genotype can be variable.
Axenfeld Rieger Anomaly (ARA) usually has an autosomal dominant inheritance pattern, with a high association with FOXC1 and PITX2 alterations. ARA causes glaucoma in 50 to 75%, thus relatives should be screened for elevated IOP and glaucoma.
Aniridia is associated with mutations in PAX6 (autosomal dominant pattern). WT1 is an adjacent gene to PAX6 and can be altered as well, causing a higher risk for nephroblastoma (WAGR syndrome: Wilms tumour, aniridia, genitourinary anomalies, retardation). Thus, WT1 should be assessed as well.

II.2.1.4.2 Glaucoma associated with non-acquired systemic disease or syndrome

- Chromosomal disorders such as Trisomy 21 (Down syndrome)
- Connective tissue disorders: Marfan syndrome Weill-Marchesani syndrome, Stickler syndrome
- Metabolic disorders: Homocysteinuria, Lowe syndrome, Mucopolysaccharidoses
- Neurocutaneous syndromes (Phacomatoses): Neurofibromatosis 1 and 2, Sturge-Weber Syndrome, Klippel-Trenaunay-Weber Syndrome, Rubinstein-Taybi
- Congenital rubella

Association with systemic disease or syndrome usually requires interdisciplinary approach Close cooperation with pediatricians, paediatric ophthalmologists and orthoptists is mandatory.

The Guidelines project was entirely supported by the European Glaucoma Society Foundation

Br J Ophthalmol: first published as 10.1136/bjophthalmol-2025-egsguidelines on 8 September 2025. Downloaded from http://bjo.bmj.com/ on September 29, 2025 by guest.
Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

II.2.1.4.3 Glaucoma associated with acquired ocular conditions

- Uveitis
- Trauma (hyphaema, angle recession, ectopia lentis)
- Steroid induced
- Tumours (benign/malignant, ocular/orbital)
- Retinopathy of prematurity

II.2.1.4.4 Glaucoma following childhood cataract surgery (GFCS)

Secondary glaucoma is a frequent serious complication after cataract surgery in early infancy. The incidence may increase up to 50% if cataract surgery is performed before the 9th month of life. The younger the child is at time of cataract surgery, the higher the risk of developing secondary glaucoma. Mechanism can be open angle (more often) or angle closure generally due to pupillary block. Low age at cataract surgery and microcornea are the main risk factors for the development of GFCS. The risk for GFCS increases with the time passed after cataract surgery, thus, life-long IOP follow-up is mandatory. Pseudophakia is not a protective factor.
The risk-benefit ratio between amblyopia and glaucoma should be evaluated carefully especially in children with unilateral cataract.
Secondary glaucoma is difficult to treat and often needs glaucoma drainage device surgery for long-term IOP control. However, surgical risks are high in this group of patients and teamwork is instrumental for the treatment of amblyopia in these children.

> Treatment has to be adapted to the underlying condition. Medications can be first choice treatment in children with some forms of secondary glaucomas and acquired conditions. IOPs should be checked in every child after cataract surgery and if glaucoma is detected, angle closure should be ruled out. Whenever possible such cases should be referred to tertiary care centres since eyes with associated anomalies/problems might be even more complex.
> For patients with systemic disorders a multidisciplinary approach is required.

Systematic review:
- Jin S, Zhang J, Wang J, et al. Advisability of primary intraocular lens implantation for infants under 2: A systematic review and meta-analysis. Int J Clin Pract 2021;75:e14143.

The Guidelines project was entirely supported by the European Glaucoma Society Foundation

Br J Ophthalmol: first published as 10.1136/bjophthalmol-2025-egsguidelines on 8 September 2025. Downloaded from http://bjo.bmj.com/ on September 29, 2025 by guest.
Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

II.2.2 Open Angle Glaucoma

II.2.2.1 Primary open angle glaucoma (POAG)

Definition: POAG is a chronic, progressive, potentially blinding, irreversible eye disease causing optic nerve rim and RNFL loss with related VF defects. Angle appearance is normal, and major risk factors include the level of IOP and older age. Visual disability is usually prevented by early diagnosis and treatment.

Aetiology/mechanism:
The aetiology remains unclear. Multiple genetic factors and the influence of co-morbidities are likely to play a role. The current concept of how damage is elicited includes deformation of the lamina cribrosa caused by IOP levels that are not tolerated by the individual eye. This is thought to result in axonal damage with consequent apoptotic death of the retinal ganglion cells. Vascular factors, oxidative stress, inflammation and mitochondrial dysfunction also probably play a role.
Any increase in IOP is caused by elevated outflow resistance mainly in the TM outflow pathways. A substantial proportion of patients develop POAG at IOPs within the normal range.
POAG has been arbitrarily subdivided into 'high pressure' and 'normal-pressure' disease, even though they represent a spectrum of optic neuropathies. It is presumed that risk factors other than IOP have a relatively greater importance if there is glaucoma at the lower pressure levels. The treatment principles are the same, but there may be some differences in clinical features. Glaucoma with lower IOP levels may be more common in women with vascular dysregulation (e.g. migraine, Raynaud). Disc haemorrhages and paracentral scotomas may be more common (See Fig II.1.11).

Epidemiology:
Glaucoma is one of the leading causes of irreversible blindness both in Europe and worldwide. POAG is unusual under the age of 40 years. Its prevalence increases with age.

Risk factors for the onset of POAG:
- Older age
- Higher IOP
- Ethnicity: the prevalence of glaucoma is highest in people of black ancestry (see glaucoma epidemiology, I.6)
- Low CCT
- Family history of glaucoma: the risk of having OAG is higher for individuals with a first-degree relative with confirmed OAG
- Myopia (significant risk increase in high degree myopia)
- Blood pressure dysregulation
- Others: cardiovascular diseases, sleep apnoea

Data from the literature on diabetes, systemic high blood pressure, migraine, Raynaud syndrome, Alzheimer´s disease and H. pylori infections are inconsistent.

The Guidelines project was entirely supported by the European Glaucoma Society Foundation

Br J Ophthalmol: first published as 10.1136/bjophthalmol-2025-egsguidelines on 8 September 2025. Downloaded from http://bjo.bmj.com/ on September 29, 2025 by guest.
Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

Risk factors for progression of POAG

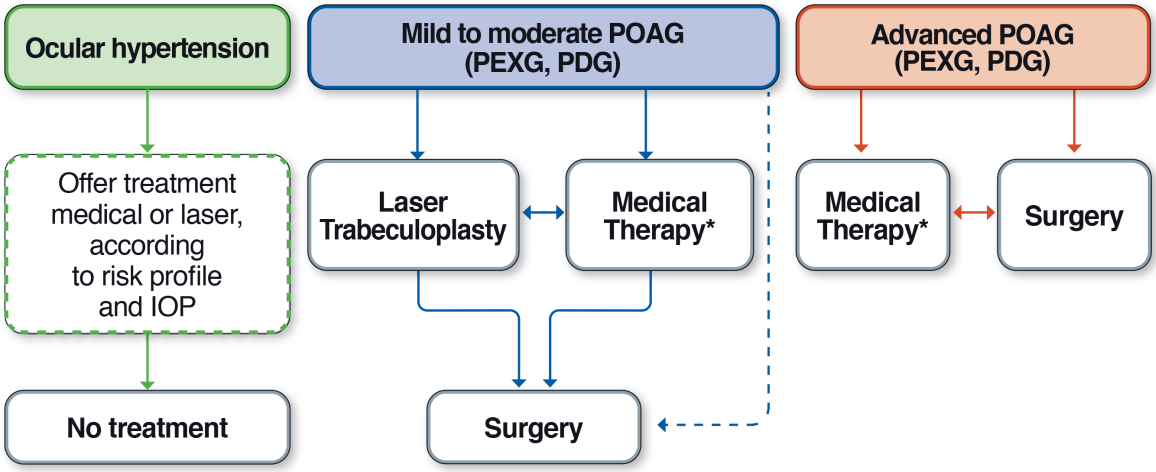
Early Manifest Glaucoma Trial (EMGT), Advanced Glaucoma Intervention Study (AGIS), Collaborative Initial Glaucoma Treatment Study (CIGTS), Collaborative Normal Tension Glaucoma Study (CNTGS) have identified the following risk factors for progression (for details on studies see I.7):

- Older age
- Higher IOP
- Presence of disc haemorrhages
- Thinner CCT is not independent prognostic factor for progression of OAG in univariate analyses

Treatment:

Choice of primary therapeutic modality needs to be made on an individual patient basis.

FC VIII Treatment options



* Up to 2-3 different drugs. Do not add a medication to a non-effective one; consider switching

POAG = primary open-angle glaucoma **PXFG = pseudoexfoliative glaucoma** **PDG = pigmentary dispersion glaucoma**

© European Glaucoma Society

The Guidelines project was entirely supported by the European Glaucoma Society Foundation

Br J Ophthalmol: first published as 10.1136/bjophthalmol-2025-egsguidelines on 8 September 2025. Downloaded from http://bjo.bmj.com/ on September 29, 2025 by guest. Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

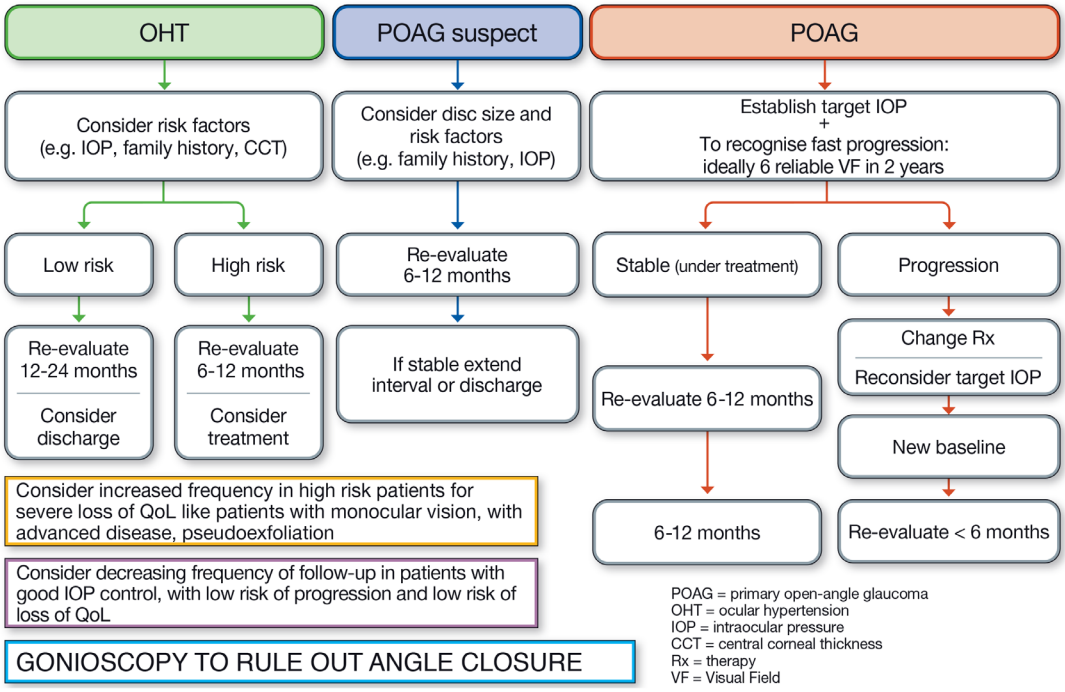
II.2.2.1.1 Primary late-onset juvenile glaucoma

Aetiology/mechanism: Decreased aqueous outflow

Features:
- Onset: beyond infancy, usually after puberty or early adulthood. Heredity: if familiar frequently dominant trait. Genes associated with primary juvenile glaucoma have been identified as MYOC (see genetics chapter II.1.6)
- Elevated IOP without treatment
- ONH and RNFL: Diffuse damage typical, but any type of glaucomatous damage
- Visual field: glaucomatous defects
- Gonioscopy: wide open anterior chamber angle, often poorly differentiated
- No congenital or developmental anomalies

Treatment:
Medical therapy: any effective and well tolerated topical regimen
Surgery: early surgery often required (filtering procedure or goniotomy/ trabeculotomy; consider antimetabolites)
Laser trabeculoplasty: not recommended

FC IX Assessment and follow-up intervals



© European Glaucoma Society

The Guidelines project was entirely supported by the European Glaucoma Society Foundation

Br J Ophthalmol: first published as 10.1136/bjophthalmol-2025-egsguidelines on 8 September 2025. Downloaded from http://bjo.bmj.com/ on September 29, 2025 by guest. Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

II.2.2.1.2 Primary open angle glaucoma suspect

Definition: A glaucoma suspect is an individual with clinical findings suggestive but not confirmatory of OAG. There may be a varying combination of borderline results concerning structural and/or functional tests. Often only time will determine whether a glaucoma suspect has early stages of glaucoma or not (See Fc IX).

Features:
- Visual field and/or optic disc and/or nerve fibre layer normal or suspicious, with at least one being suspicious
- IOP can be normal or increased

Treatment (See Fc VI):
Risks and benefits of treatment need to be weighed against the risk of the development of glaucomatous damage. The indication for any form of therapy is relative and may be discussed with the patient. In general, treatment is not necessary if the IOP is not elevated. Follow-up at intervals of 6-12 months initially, to be prolonged or the patient discharged if all parameters remain unchanged.

II.2.2.1.3 Ocular Hypertension

Features:
- IOP >21 mmHg without treatment
- Visual field: normal
- Optic disc and retinal nerve fiber layer: normal
- Gonioscopy: open anterior chamber angle (exclude intermittent angle closure, (see II.2.4.1)
- No history or signs of other eye disease or steroid use

Risk factors for the conversion of OHT to POAG:
The following risk factors and predictive factors were consistently reported in both the Ocular Hypertension Treatment Study OHTS and the European Glaucoma Prevention Study EGPS (for details on the studies see I.1.7):
- Older age
- Higher IOP
- Thinner CCT

A risk calculator is freely available to estimate the risk of developing glaucoma at 5 years, https://ohts.wustl.edu/risk/

The Guidelines project was entirely supported by the European Glaucoma Society Foundation

Br J Ophthalmol: first published as 10.1136/bjophthalmol-2025-egsguidelines on 8 September 2025. Downloaded from http://bjo.bmj.com/ on September 29, 2025 by guest.
Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

Treatment:
Treatment may be advisable in people with high risk of conversion to glaucoma. Other factors like life expectancy, overall health, and the likelihood of meaningful visual impairment also should be taken into account when making de decision to treat.
Increased IOP should be confirmed before starting treatment unless very high. In general offer treatment in patients with repeated IOPs in the high twenties, even without additional risk factors. Treatment principles and choices will be similar to those for POAG. The initial approach is to offer either medical treatment or laser trabeculoplasty.
Follow-up at intervals of 6-12 months initially, to be prolonged if all parameters remain stable.
See Fc IX.

Assess each patient individually when deciding whether or not to offer treatment.
Involve the patient.
Ask their opinion.

The Guidelines project was entirely supported by the European Glaucoma Society Foundation

Br J Ophthalmol: first published as 10.1136/bjophthalmol-2025-egsguidelines on 8 September 2025. Downloaded from http://bjo.bmj.com/ on September 29, 2025 by guest.
Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

II.2.3 Secondary open angle glaucoma

Definition: Secondary open angle glaucomas (OAG) are a heterogeneous group of conditions, in which elevated IOP is the leading pathological factor causing the glaucomatous optic neuropathy. Most forms of secondary glaucoma have complex mechanisms which can overlap or evolve to angle closure.

II.2.3.1 Secondary open angle glaucoma caused by ocular disease

II.2.3.1.1 Pseudoexfoliative or exfoliative glaucoma (PXFG)

Epidemiology: Pseudoexfoliative glaucoma (PXFG) is the most common type of secondary OAG, its prevalence varies considerably across populations. According to population based data, PXFG develops in approximately 15% to 26% of eyes with OHT and pseudoexfoliation syndrome (PXF) over a 5 year period. PXF/PXFG may be associated with systemic diseases (e.g. vascular diseases, inguinal hernia and female's pelvic organ prolapse. Progression of PXFG is approximately 3 times faster than that of POAG.

Aetiology/mechanism:
PXFG develops from PXF, in which an abnormal fibrillo-granular protein (pseudoexfoliation material) is produced in the eye.
Genetics: Development of PXF is strongly associated with certain gene variants including LOXL1. The development of PXFG from PXF is probably influenced by environmental factors.

Features:
- Onset: usually older than 50 years with large between-population variability
- Pseudoexfoliation material accumulates in a characteristic pattern on the anterior lens capsule - better visualised after pupil dilatation, pupillary margin, TM and the zonules
- Pigment loss from the pupil margin is common ("moth eaten pupil")
- On cross sectional assessment one or both eyes may show clinically signs of PXFG; often bilateral and asymmetrical
- IOP is higher than that in POAG, and diurnal IOP fluctuation is high
- VF/ONH damage is frequently advanced in the worse eye at diagnosis
- The angle can be wide open, narrow or closed when the lens moves anteriorly due to zonular laxity
- On gonioscopy, Sampaolesi's line (pigment deposition anterior to Schwalbe's line) is common and characteristic for PXFG and TM usually shows dense pigmentation, often with uneven distribution ("salt and pepper" appearance)

The Guidelines project was entirely supported by the European Glaucoma Society Foundation

Br J Ophthalmol: first published as 10.1136/bjophthalmol-2025-egsguidelines on 8 September 2025. Downloaded from http://bjo.bmj.com/ on September 29, 2025 by guest.
Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

- Due to progressive zonular damage, phacodonesis and lens subluxation are not uncommon, and the complication rate of cataract surgery may be increased.
- Late in-the-bag intraocular lens (IOL) dislocation several years after uncomplicated cataract surgery is not uncommon.

Treatment:
Treatment options for PXFG are similar to those of POAG although there is higher risk of progression in PXFG. Laser trabeculoplasty and medical treatment are equally effective but both lose efficacy over time. In clinically unilateral PXFG the fellow eye also needs to be regularly checked for IOP elevation and glaucoma since the conversion rate is high (see II.3).

II.2.3.1.2 Pigmentary glaucoma (PG)

Epidemiology: PG represents 1-1.5% of all glaucoma cases. It is more common in white Caucasian myopic men. It is typically diagnosed at the age of 30-50 years. The reported risk of developing glaucoma in patients with pigment dispersion syndrome (PDS) in clinic populations ranges from 10 to 50%, but this may represent a biased population of individuals with PDS and raised IOP.

Mechanism:
Melanin pigment is released from the iris pigmented epithelium as the result of rubbing between lens zonules and posterior surface of the iris. Posterior bowing of the iris with "reverse pupillary block" configuration is noted in many eyes with pigment dispersion.
Melanin granules cause an increase of TM outflow resistance and hence an elevation of IOP. The current understanding is that TM cells phagocytose pigment, which subsequently leads to their death.

Two entities can be described:
- PDS: usually bilateral characterized by dispersion of iris pigment, may be associated with elevated IOP
- PG: glaucomatous optic neuropathy and PDS

Features:
- Midperipheral iris transillumination with a radial spoke like pattern due to pigment loss best visible with retroillumination
- Pigment deposition in the corneal endothelium typically accumulating vertically as Krukenberg spindle (frequently seen, but not pathognomonic)
- Homogenously dark brown, densely pigmented TM
- Pigment deposition along the insertion of the zonular fibres into the lens, known as Scheie stripe' or 'Zentmayer's ring'
- Very deep anterior chamber with backward bowing of the peripheral iris (see gonioscopy chapter)
- Transient blurry vision due to IOP spikes (often after exercise or pupillary dilatation)

The Guidelines project was entirely supported by the European Glaucoma Society Foundation

Br J Ophthalmol: first published as 10.1136/bjophthalmol-2025-egsguidelines on 8 September 2025. Downloaded from http://bjo.bmj.com/ on September 29, 2025 by guest.
Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

Treatment:
Treatment of PG is similar to that of POAG. No PG-specific treatment is available. Laser trabeculoplasty and medical treatment are equally effective, but spikes of IOP are common after laser trabeculoplasty and so should be performed cautiously with low power settings and with prophylactic treatment to prevent IOP spikes (see II.3). Peripheral iridotomy is controversial but may be considered in selected patients.

II.2.3.1.3 Lens-induced open angle glaucoma

Aetiology/mechanism:
In lens-induced OAG, TM outflow pathways are obstructed by lens particles and/or inflammatory cells.
- Phacoemulsificationlytic glaucoma: the TM is obstructed by lens material leaking from mature or hypermature cataract
- Traumatic lens injury: the TM is obstructed by lens particles from a traumatically or surgically injured lens
- Phacoemulsificationanaphylactic glaucoma: lens proteins lead to granulomatous uveitis affecting the TM

Features:
- Unilateral pain with redness and inflammation
- Reduced vision and elevated IOP
- Signs of injured lens and/or mature/hypermature cataract are present, with or with- out anterior uveitis (aqueous flare and keratic precipitates)

Treatment:
Intensive topical steroids and IOP lowering medications, extraction of lens or lens fragments, vitrectomy if needed.

II.2.3.1.4 Glaucoma associated with intraocular haemorrhage

Aetiology/mechanism:
Non-traumatic acute bleeding (e.g. UGH-syndrome, haematological alterations, iris abnormalities) in the anterior chamber or long-standing blood in the vitreous can cause IOP elevation. Red blood cells (hyphaema) or haemoglobin-laden macrophages along with red blood cells debris (haemolytic glaucoma) or degenerated red blood cells (ghost cell glaucoma) cause TM dysfunction.

Features:
- Pain and eye irritation
- Elevated IOP is more common with larger hyphaemas and is more often due to recurrent haemorrhage or re-bleeding
- “Ghost cells” are degenerated erythrocytes which assume a spherical shape and a khaki colour, which occur 1 to 4 weeks after a vitreous haemorrhage (secondary to

The Guidelines project was entirely supported by the European Glaucoma Society Foundation

Br J Ophthalmol: first published as 10.1136/bjophthalmol-2025-egsguidelines on 8 September 2025. Downloaded from http://bjo.bmj.com/ on September 29, 2025 by guest.
Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

either trauma, retinal disease or intraocular surgery) and migrate through a disrupted anterior hyaloid surface in the anterior chamber, where they may be seen circulating or layering over the inferior part of TM at gonioscopic examination. Intraocular haemorrhages may also cause haemolytic glaucoma, in which red-tinged cells in the AH and reddish brown pigmented deposits of the TM are present. Overall, the clinical pictures of ghost-cell glaucoma and haemolytic glaucoma are similar
- Always exclude angle neovascularization, especially in case of vitreous haemorrage and history of diabetes or previous retinal vascular diseases

Treatment:
- Topical and systemic IOP lowering medication as needed. It is recommended to avoid carbonic anhydrase inhibitors and hyperosmotic agents in patients with sickle cell disease
- Conservative treatment, bed rest, topical cycloplegics and steroids, can be considered for uncomplicated hyphaema. Antifibrinolytic agents such as tranexamic acid can reduce the risk of rebleeding. However it is not clear whether any of the interventions have an effect on visual acuity
- Wash-out through a paracentesis of the anterior chamber and/or vitrectomy to remove RBCs from vitreous if IOP remains high with the risk of corneal blood staining and/or optic neuropathy
- Consider intravitreal anti-VEGF in case of retinal vascular disease as the cause of vitreous bleeding. Care should be taken to control IOP spikes

II.2.3.1.5 Uveitic glaucoma

Aetiology/mechanism:
In acute uveitis, the IOP often drops, probably due to a combination of reduced aqueous production caused by inflammation of the ciliary body and an increased uveoscleral outflow caused by prostaglandin release. However, IOP increase and secondary glaucoma may develop during the course of the disease.
Chronic IOP elevation is typical for Fuchs' Heterochromic Uveitis, juvenile idiopathic arthritis, Behçet disease, pars planitis, sympathetic ophthalmia, sarcoidosis and syphilis. Acute IOP elevation may also occur and it is typical of Posner-Schlossman syndrome or viral infections such as herpes simplex virus, varicella-zoster virus and cytomegalovirus.

Features:
- Obstruction and dysfunction of the TM are caused by inflammatory cells, precipitates, debris, secondary scarring and neovascularisation of the chamber angle. Inflammation of the TM or trabeculitis has been proposed in Posner-Schlossman and viral keratouveitis to explain the disproportion of IOP increase and degree of visible anterior segment inflammation
- Secondary angle closure may develop due to synechial closure of the chamber angle or seclusio pupillae with subsequent iris bombé and appositional angle closure (see Ch II.2.5.1)
- Corticosteroid treatment can also contribute to IOP elevation in some patients

The Guidelines project was entirely supported by the European Glaucoma Society Foundation

Br J Ophthalmol: first published as 10.1136/bjophthalmol-2025-egsguidelines on 8 September 2025. Downloaded from http://bjo.bmj.com/ on September 29, 2025 by guest.
Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

Treatment:
- The goal is the simultaneous treatment of both uveitis and IOP elevation
- Topical and systemic anti-inflammatory therapy according to the underlying disease
- Topical and systemic IOP lowering medication
- Joint management with uveitis specialist especially for complex cases (e.g. for patients with corticosteroid-induced IOP elevation in order to adequately control the inflammation by other immunosuppresive drugs)
- Consider aqueous humour analysis to confirm/exclude viral infection in selected patients
- Ensure adequate antiviral (usually systemic) treatment when viral infection is suspected or confirmed by AH analysis
- Traditionally topical β-blockers and CAIs have been used as first-line treatment
- PGAs can be used therapy in eyes with well controlled uveitis
- Laser trabeculoplasty should be avoided in the acute phase

Acute IOP elevation with corneal oedema but open angle may result from Posner-Schlossman syndrome (iridocyclitic crisis), or from endotheliitis/trabeculitis as in herpetic or cytomegalovirus eye disease.

II.2.3.1.6 Neovascular glaucoma

(see also II.2.5.2.1)

II.2.3.1.7 Glaucoma due to intraocular tumours

Aetiology/mechanism:
Reduced AH outflow due to primary or secondary intraocular tumours, mainly of the anterior segment.
Infiltration of the TM by the tumour or tumour cells floating in the AH. TM obstruction due to tumour related inflammation, tumour debris, haemorrhage or pigment dispersion. Secondary ACG may also develop.

Features:
- Elevated IOP
- A highly variable clinical picture, combining evidence of both tumour and glaucoma

Treatment:
- Treatment of underlying tumour (irradiation, surgical tumour excision, enucleation)
- Topical and systemic IOP lowering medication; medical therapy is often first-line treatment while awaiting definitive treatment
- Cyclodestructive procedures
- Incisional glaucoma surgery indicated only after successful tumour control

The Guidelines project was entirely supported by the European Glaucoma Society Foundation

Br J Ophthalmol: first published as 10.1136/bjophthalmol-2025-egsguidelines on 8 September 2025. Downloaded from http://bjo.bmj.com/ on September 29, 2025 by guest. Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

II.2.3.2 Secondary open angle glaucoma due to ocular trauma

Ocular trauma leads to glaucoma by several different mechanisms. The secondary traumatic glaucomas can be caused by both open angle and angle closure mechanisms. In order to identify and treat the causes of IOP elevation; careful evaluation of the ocular damage must be performed (See Ch I.1.2.1.2).

Aetiology/mechanism:
Blunt non-penetrating or penetrating trauma to the eye can damage intraocular structures.
Any trauma can lead to reduced trabecular outflow due to traumatic changes of the TM (scarring and inflammation, angle recession).
Hyphema is the most common complication following blunt-non penetrating trauma. Vitreous hemorrhages hemolytic hyphema associated with perforating/penetrating or non-perforating/non-penetrating trauma may lead to ghost cell/hemolytic glaucoma (see Ch II.2.3.1.4).
Lens induced glaucoma is also possible (see Ch II.2.3.1.3).

Features:
- Elevated IOP may be acute (usually related to obstruction of the TM by red blood cells but also possible without hyphema due to inflammatory cells/debris blockage of the TM) or occur late (e.g after 2-3 weeks like in ghost cell glaucoma) and also a very long time after the trauma (years, like in case of angle recession)
- Clinical features depend on the aetiology of the trauma
- Rebleeding in the anterior chamber may occur after 3-7 days as the initial clot begins to retract and lyse
- Gonioscopy is essential to identify angle recession or other post-traumatic alterations but it is not recommended in fresh ocular trauma (it can be delayed for some weeks)

Treatment:
- Anti-inflammatory medication
- Topical and systemic IOP lowering medication
- Surgery (anterior chamber washout) if the IOP remains elevated despite medical treatment or there is risk of corneal staining or in case of lens damage
- Long-term IOP lowering and/or follow-up in the presence of permanent anterior segment damage (as a general rule, patients with angle recession and normal IOP should be examined annually for life)
- Glaucoma surgery when medical treatment alone does not allow adequate IOP control
- Consider pausing anti-coagulation if possible and the use of anti-fibrinolytic agents

The Guidelines project was entirely supported by the European Glaucoma Society Foundation

Br J Ophthalmol: first published as 10.1136/bjophthalmol-2025-egsguidelines on 8 September 2025. Downloaded from http://bjo.bmj.com/ on September 29, 2025 by guest.
Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

II.2.3.3 Iatrogenic secondary open angle glaucoma

II.2.3.3.1 Glaucoma due to corticosteroid treatment

Aetiology/mechanism:
Topical and intravitreal corticosteroid are evidence-based risk factors for IOP increase. Long-term systemic corticosteroid therapy also with nasal sprays, inhalers or periocular skin formulations may also affect IOP. The risk of IOP elevation depends on the chemical structure (strength) of the steroid, dose, frequency and duration of therapy, and route of administration. Corticosteroids induce changes in the trabecular extracellular matrix (glycoproteins) which lead to decreased outflow facility. A *TIGR* gene may be involved.

Features:
- Elevated IOP usually develops 2 to 6 weeks after initiating corticosteroids, but may occur at any time
- Usually IOP elevation is slowly reversed after stopping the use of corticosteroid

Treatment:
- Discontinuation of corticosteroid therapy is recommended if possible; steroid-sparing therapy of underlying condition should be considered. If this is not possible, consider switching to weaker steroid (e.g. loteprednol, fluorometholone)
- Topical and systemic IOP lowering medication
- Laser trabeculoplasty
- Glaucoma surgery may be performed in intractable cases

II.2.3.3.2 Secondary open angle glaucoma due to anterior segment ocular surgery and laser

Ocular surgery can cause IOP increase and eventually glaucomatous optic nerve damage by some of the mechanisms discussed above: intraocular haemorrhage, inflammatory reaction, lens material, pigmentary loss from uveal tissue, or trauma.

Aetiology/mechanism:
IOP elevation after anterior segment intraocular surgery is usually transient and is a result of reduced TM outflow which may be caused by: viscoelastic material, inflammatory debris, vitreous in the anterior chamber after cataract surgery, lens particles, prostaglandin release and fibrosis if not properly treated.
Acute onset secondary IOP elevation after neodymium-doped yttrium aluminum garnet (Nd:YAG) LPI, capsulotomy and laser trabeculoplasty. IOP elevation is usually transient, within the first 24 hours, most frequent in the first 4 hours after treatment.

The Guidelines project was entirely supported by the European Glaucoma Society Foundation

Br J Ophthalmol: first published as 10.1136/bjophthalmol-2025-egsguidelines on 8 September 2025. Downloaded from http://bjo.bmj.com/ on September 29, 2025 by guest.
Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

Treatment:
- Topical and systemic IOP-lowering medication
- Anti-inflammatory treatment
- Anterior chamber paracentesis immediately reduces the IOP and can be performed
- Removal of lens material (timing based on severity, duration and response to medical treatment of inflammation and IOP increase)
- Removal of the intraocular lens may be needed in case of UGH syndrome
- Glaucoma surgery according to the specific condition

II.2.3.3.3 Glaucoma associated with vitreoretinal surgery

Aetiology/mechanism:
IOP elevation after vitreoretinal surgery may be due to either open angle and angle closure mechanisms. IOP elevation with open angle may develop after vitrectomy with tamponading substances implantation, generally described as silicone oil induced glaucoma, as a result of:
- Migration of silicone oil into anterior chamber and obstruction of the TM (early post-op IOP increase) usually due to overfill of oil
- Migration of emulsified silicone oil into anterior chamber with obstruction of TM where oil particles are partially phagocytosed by macrophages and accumulate in the TM especially in the upper quadrant and can induce trabeculitis (intermediate and late onset IOP increase)
- Prolonged contact of silicone oil with the TM may cause permanent structural changes. Risk factors for developing IOP elevation following vitrectomy with silicone oil implantation include pre-existing OHT or glaucoma, diabetes mellitus, and aphakia (closed angle type)

Treatment:
- Topical and systemic IOP-lowering medication
- Anti-inflammatory treatment
- Removal of silicone oil may be considered in eyes with IOP elevation secondary to silicone oil emulsification. However current data suggest that removal of silicone oil is not effective in all cases and the risk of re-detachment increases
- Trans-scleral cyclophotocoagulation and aqueous drainage devices seem to represent more effective options, although the latter are associated with the risk of silicone oil escape into subconjuctival space
- Endoscopic cyclophotocoagulation in eyes requiring silicone oil removal and glaucoma treatment is another option
- Conventional filtration surgery is associated with poor prognosis

The Guidelines project was entirely supported by the European Glaucoma Society Foundation

Br J Ophthalmol: first published as 10.1136/bjophthalmol-2025-egsguidelines on 8 September 2025. Downloaded from http://bjo.bmj.com/ on September 29, 2025 by guest.
Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

II.2.3.4 Secondary open angle glaucoma caused by extraocular disease

II.2.3.4.1 Glaucoma caused by increased episcleral venous pressure

Aetiology/mechanism:
Episcleral, orbital or systemic diseases can cause the elevation of episcleral venous pressure with subsequent reduction of trabecular outflow and IOP elevation. The following disorders can be described:

- Episcleral and orbital causes: chemical burn or radiation damage of the episcleral veins, hemangioma in Sturge-Weber syndrome, naevus of Ota, endocrine orbitopathy, orbital (retrobulbar) tumour, pseudotumour, orbital phlebitis, orbital or intracranial arteriovenous fistula
- Neurological conditions: dural shunts, cavernous sinus thrombosis
- Other systemic causes: superior vena cava obstruction, jugular vein obstruction (radical neck dissection), pulmonary venous obstruction
- Idiopathic forms

Features:
IOP elevation can be acute with eye irritation and pain. Dilated, congested episcleral veins, chemosis, facial lymphoedema, orbital bruit can be present. Vascular bruits are characteristic signs of A/V fistulae.

Treatment:

- Treatment of the underlying disease
- Topical and systemic IOP-lowering medication
- Glaucoma surgery

See Fc II

The Guidelines project was entirely supported by the European Glaucoma Society Foundation

Br J Ophthalmol: first published as 10.1136/bjophthalmol-2025-egsguidelines on 8 September 2025. Downloaded from http://bjo.bmj.com/ on September 29, 2025 by guest.
Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

II.2.4 Angle closure

Angle closure refers to closure of the iridocorneal angle due to contact between the iris and trabecular meshwork. It is usually defined by iridotrabecular contact (ITC) of ≥180 degrees. ITC may be appositional (reversible with indentation gonioscopy or with pupil constriction due to light or miotics) or synechial. Gonioscopy is the definitive test for diagnosis of angle closure. Anterior segment OCT (AS-OCT) may be used as a supplementary test, e.g. for triage, but it cannot replace gonioscopy for diagnosis. AS-OCT tends to identify more ITC than gonioscopy. Though angle closure increases the risk of glaucoma, angle closure glaucoma is only present when there is both significant ITC and glaucomatous optic neuropathy.
Primary angle closure is the most common subtype of angle closure, but ITC may also occur secondary to anomalies of the iris, lens or due to factors posterior to the lens. Acute angle closure, which can cause sudden visual loss, is an emergency, however the majority of angle closure glaucoma has a gradual onset and is typically asymptomatic in its early stages. In all cases of angle closure it is essential to establish the mechanism and consider possible precipitating medications.

Mechanism
Angle closure can be classified by the mechanism leading to iridotrabecular contact into 4 categories listed from anterior to posterior: 1) at the level of the pupil, 2) at the level of the ciliary body, 3) at the level of lens, and 4) factors behind the lens. Anterior mechanisms (1 and 2) and posterior mechanisms (3 and 4) should be differentiated due to key differences in management. Of note, treatment with miotics for angle closure due to pupil block may worsen angle closure due to posterior mechanisms. See Fc X, XI, XII.

I. Pupillary block
Obstruction at the level of the pupil is the most common mechanism of angle closure, accounting for up to 75% of cases. Pupillary block is an exaggeration of a physiological phenomenon in which the aqueous flows from the posterior chamber through the pupil to the anterior chamber without any resitance. When some resistance to such flow arises, usually at the pupil causing pressure to be higher in the posterior chamber compared to anterior chamber, the iris bows forward and the peripheral iris may touch the trabecular meshwork (TM) causing irido-trabecular contact (ITC). The peripheral and mid-peripheral anterior chamber is typically shallow with the central anterior chamber relatively deep. Pupillary block may also contribute to secondary angle closure, e.g. in case of pupil seclusion induced by uveitis leading to iris bombèe causing 360-degree posterior synechiae.

II. At the level of ciliary body
Angle closure may also occur due to anterior non-pupil block mechanisms such as plateau iris. See Fig II.1.5.
Plateau iris configuration is characterised by appositional ITC with a flat iris configuration. The peripheral anterior chamber is shallow, but the central AC is typically deep, with the double hump sign visible on dynamic gonioscopy (See gonioscopy chapter). This is due to anteriorly placed ciliary processes pushing the peripheral iris forward, visible as a peripheral hump. Anteriorly positioned ciliary

The Guidelines project was entirely supported by the European Glaucoma Society Foundation

Br J Ophthalmol: first published as 10.1136/bjophthalmol-2025-egsguidelines on 8 September 2025. Downloaded from http://bjo.bmj.com/ on September 29, 2025 by guest.
Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

body processes can occur with co-existing pupil block which can push forward the iris causing the double hump. Relief of the pupillary block component using laser iridotomy may be required to identify plateau iris.
Plateau iris syndrome refers to a situation where a patent iridotomy was used to eliminate the pupillary block component but appositional ITC persists. Angle closure in emmetropic or myopic younger people (≤40 years) should raise high suspicion of plateau iris. Pupil block and plateau iris mechanisms may coexist.

III. At the level of the lens
The lens plays an important role in the mechanism of pupil block, but the term lens-induced angle closure is reserved for about 5% of cases where the lens is the unique cause. For example:
- White or intumescent cataract, e.g., delayed diagnosis or post-trauma
- Lens subluxation with anterior displacement, e.g., PXF, Marfan syndrome or trauma

In lens-induced angle closure the anterior chamber tends to be uniformly shallow.

IV. Posterior to the lens
Aqueous misdirection, also called malignant glaucoma, is an uncommon form of angle closure. The mechanism is uncertain but likely involves increased choroidal volume and impaired fluid movement from posterior to anterior segments with posterior misdirection of aqueous possibly accumulating in the vitreous. The lens/ iris diaphragm is pushed forward and occludes the anterior chamber angle. The anterior chamber is uniformly very shallow. Aqueous misdirection usually occurs after surgery in eyes with short axial length. IOP may be normal at early stages.
- Other posterior pushing mechanism, e.g. tumour, retinal gas or oil tamponade, uveal effusion (e.g. spontaneous, drug-induced) may cause angle closure by forward movement of the lens-iris diaphragm which may be variably combined with pupillary block.

II.2.4.1 Primary angle closure glaucoma

Primary angle closure glaucoma (PACG) affects approximately 20 million people globally, compared to 60 million with POAG. PACG disproportionally accounts for 50% of glaucoma blindness, thus showing a higher rate of visual loss than POAG. The prevalence of PACG in white European adults aged over 40 years is approximately 0.4% (incidence 2-5/100,000 per year) compared to 2.5% for POAG. PACG therefore accounts for approximately 1 in 6 cases of glaucoma in white European adults. It is more common in Chinese (12-16/100,000 per year) and South and South-east Asian people (6-7/100,000 per year). Patients with suspected glaucoma should be assumed to have angle closure until proved otherwise.

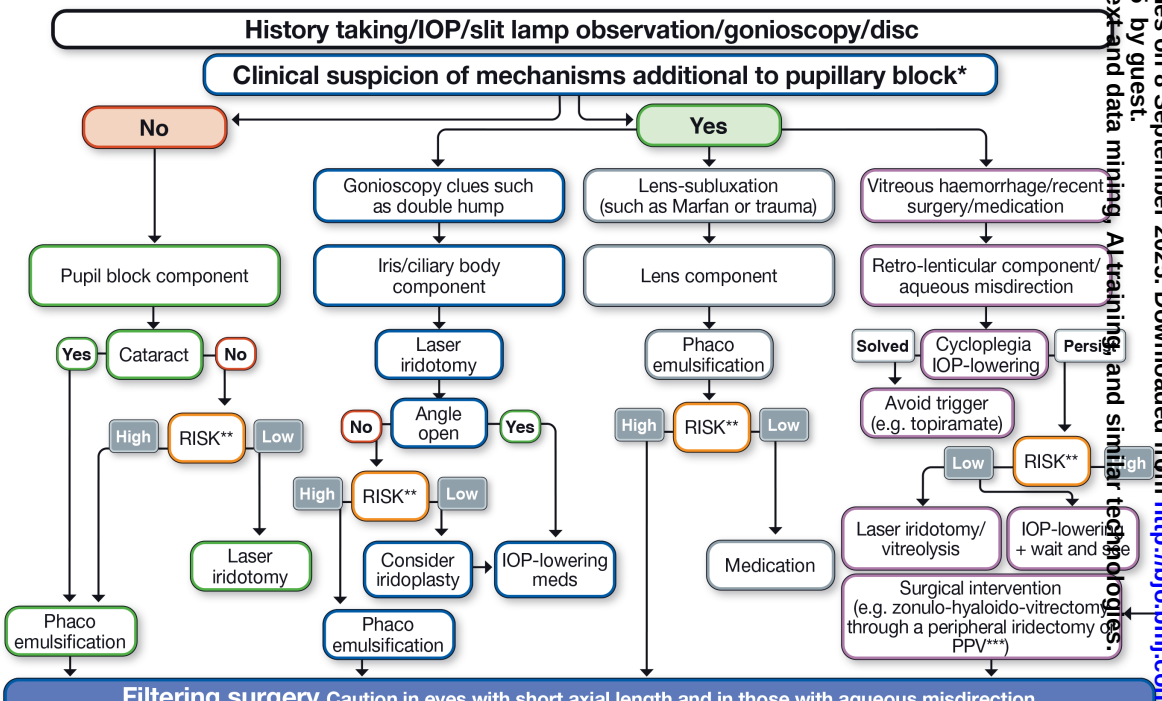
The Guidelines project was entirely supported by the European Glaucoma Society Foundation

Br J Ophthalmol: first published as 10.1136/bjophthalmol-2025-egsguidelines on 8 September 2025. Downloaded from http://bjo.bmj.com/ on September 29, 2025 by guest.
Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

The natural history of PAC disease has three stages:

1. Primary angle closure suspect (PACS)
- ≥180 degrees of ITC with normal IOP and no peripheral anterior synechiae (PAS) and no evidence of glaucomatous optic neuropathy.
2. Primary angle closure (PAC)
- ≥180 degrees of ITC in combination with raised IOP and/or PAS. There is no evidence of glaucomatous optic neuropathy.
3. Primary angle closure glaucoma (PACG)
- ≥180 degrees of ITC with glaucomatous optic neuropathy.

FC X Initial management of angle closure



* Clinical suspicion of secondary causes: asymmetrical AC depth; sudden unilateral; recent eye surgery ** See Ch II.2.4.1 *** PPV: pars plana vitrectomy

© European Glaucoma Society

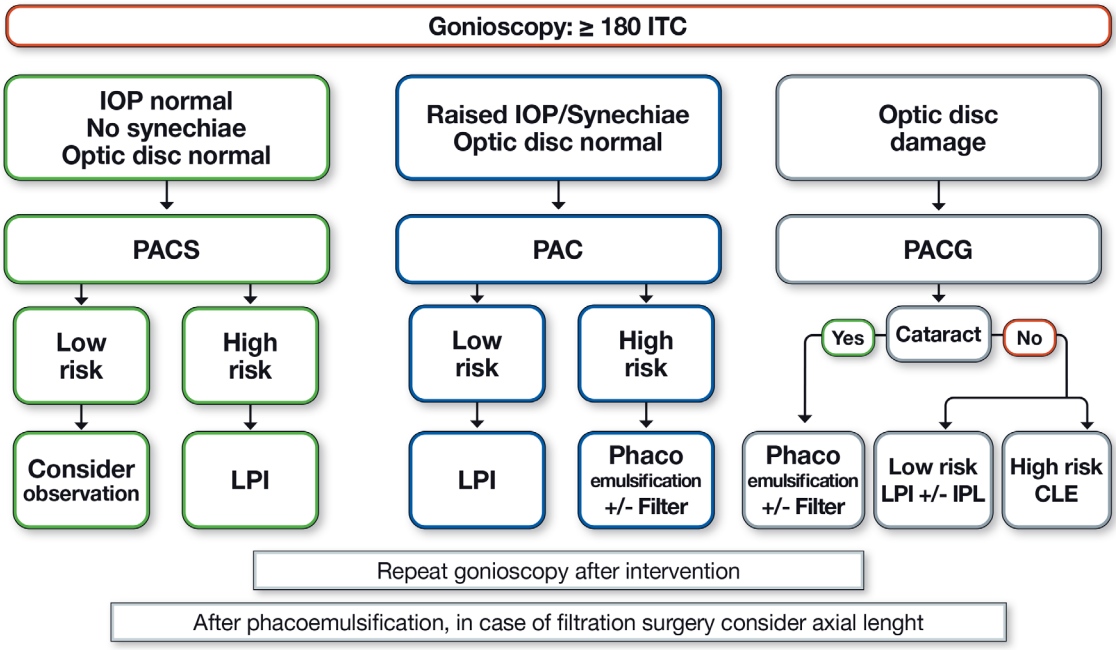
The Guidelines project was entirely supported by the European Glaucoma Society Foundation

Br J Ophthalmol: first published as 10.1136/bjophthalmol-2025-egsguidelines on 8 September 2025. Downloaded from http://bjo.bmj.com/ on September 29, 2025 by guest. Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

Clinical features:
Most patients with angle closure are asymptomatic. Although symptoms of pain, redness, blurring of vision or haloes may help identify those with sub-acute episodes of IOP elevation due to angle closure, the sensitivity and specificity of symptoms for identifying angle closure is very poor.
See Fc XI

Diagnosis:
Gonioscopy is the best technique for confirming ITC and diagnosing angle closure. It is the only method that allows a 360-degree stereoscopic and dynamic assessment of the angle. AS-OCT can provide a supplementary non-contact method for quantifying anterior chamber anatomy, but it cannot replace gonioscopy for diagnosis. Using AS-OCT, identification of the key landmark of the scleral spur may be difficult in some eyes, as may detection of ciliary processes or PAS. AS-OCT tends to identify more ITC than gonioscopy resulting in false positives. AS-OCT may be useful for demonstrating to patients the mechanism of their problem and for documenting changes in angle width after iridotomy.

FC XI Management of primary angle closure



ITC = Irido Trabecular Contact **LPI = Laser Peripheral Iridotomy** **IPL = Iridoplasty** **CLE = Clear Lens Extraction**
* See Ch II.2.4.1

© European Glaucoma Society

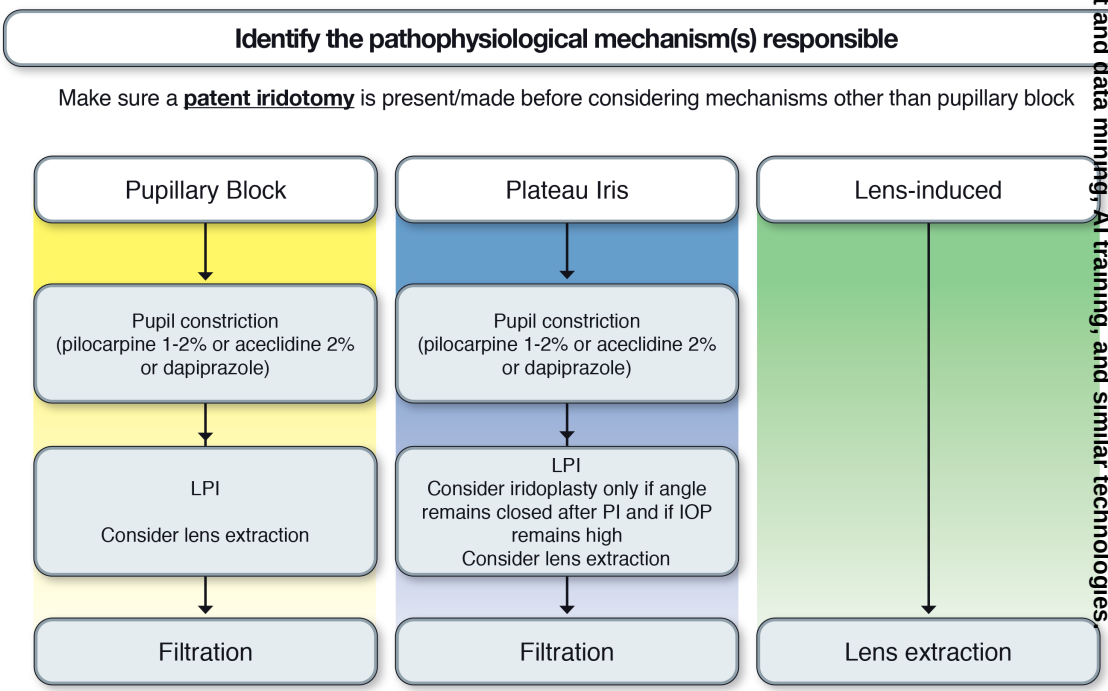
The Guidelines project was entirely supported by the European Glaucoma Society Foundation

Br J Ophthalmol: first published as 10.1136/bjophthalmol-2025-egsguidelines on 8 September 2025. Downloaded from http://bjo.bmj.com/ on September 29, 2025 by guest.
Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

Limbal anterior chamber depth (LACD) (≤25%) or Van Herick test (grade 2) at the temporal limbus has high sensitivity and specificity for angle closure. See Fig. II.1.8.
A Cochrane review found a LACD threshold of ≤25% had a pooled sensitivity and specificity of 0.83 (95% CI 0.74 to 0.90) and 0.88 (95% CI 0.84 to 0.92) respectively, however there is a need for high quality studies to evaluate the performance of AS-OCT and LACD and to evaluate their role as triage tests.
Provocative tests for angle closure are not recommended. Provocation with pharmacological dilation of the pupil does not mimic physiological conditions and there is no good quality evidence that pharmacological or dark prone provocation tests are useful for identifying high risk individuals. See Fc X and XI.

Risk factors:
Risk factors for the spectrum of PAC disease include older age, family history, hypermetropia, and race, being more common in Inuits and South and East Asians e.g. Chinese. Three-quarters of cases occur in females. Other factors associated with PAC include a thick peripheral iris, a more anterior iris insertion, and more prominent and

FC XII Management of chronic angle closure



* See Ch II.2.4

© European Glaucoma Society

The Guidelines project was entirely supported by the European Glaucoma Society Foundation

Br J Ophthalmol: first published as 10.1136/bjophthalmol-2025-egsguidelines on 8 September 2025. Downloaded from http://bjo.bmj.com/ on September 29, 2025 by guest. Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

anterior lens vault. PXF may also be associated with PACG, probably due to zonular instability. In most cases, the predisposition to pupillary block and angle closure is due to a small anterior segment and to the age-related increased lens volume. Though there is a relationship between hypermetropia and PAC, angle closure also occurs in myopes, and refraction should not be used to determine which patients are assessed for risk of PAC. The COL11A1 gene (the gene related to Stickler's syndrome) is associated with increased risk of angle closure disease. Angle closure is also associated with connective diseases including Marfan/ Weill Marchesani syndrome and Ehler-Danlos syndrome and ocular diseases including retinitis pigmentosa and Best Vitelliform Macular Dystrophy. First-degree relatives of those with angle closure glaucoma should have regular eye examinations.

Treatment:
Treatment options for pupil block/PAC disease include LPI or due to the central role of the lens, cataract surgery or lens extraction (for high-risk cases). If there is symptomatic cataract, prompt cataract surgery is recommended. There is no evidence to support clear lens extraction for preventing glaucomatous visual loss in PACS or low risk PAC. Medical treatment for elevated IOP should be accompanied by a laser or surgical intervention to reverse ITC and reduce the risk of irreversible damage to the trabecular meshwork. See Ch I.2.2 and I.2.4.

Systematic review:
- Jindal A, Ctori I, Virgili G, Lucenteforte E, Lawrenson JG. Non-contact tests for identifying people at risk of primary angle closure glaucoma. Cochrane Database Syst Rev. 2020 May 28;5(5):CD012947. doi: 10.1002/14651858.CD012947.pub2. PMID: 32468576; PMCID: PMC7390269.

II.2.4.1.1 Primary angle closure suspect (PACS)

Risk of progression:
The short to medium term risk of progression to acute angle closure or to PACG in people with PACS and no other abnormality is low. In a Chinese population, the ZAP study found 36 of 889 untreated eyes with PACS progressed to develop PAS (30 eyes), elevated IOP (5 eyes) or acute angle closure (5 eyes) over 6 years. No patients developed glaucomatous optic neuropathy. This equates to a risk of acute angle closure in those with PACS and no other risk factors of around 1/1000 per year. At 14 years, 105 of 889 untreated eyes had reached one of these primary endpoints, however, almost all were due to PAS (98 PAS, 6 raised IOP, 5 acute angle closure). In the ANA- LIS study, also performed in a Chinese population of PACS eyes, the incidence rate for developmed for PAC or PACG was 21.84/1000 eyes per year in the control group. Older age and higher post dilatation IOP were associated with an increased risk.
However, patients seen at tertiary referral centres may represent more advanced cases with respect to ocular biometrics parameters and may be at higher risk compared to ZAP or ANA-LIS trial participants. See Ch I.2.2.

The Guidelines project was entirely supported by the European Glaucoma Society Foundation

Br J Ophthalmol: first published as 10.1136/bjophthalmol-2025-egsguidelines on 8 September 2025. Downloaded from http://bjo.bmj.com/ on September 29, 2025 by guest. Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

Treatment:
Treatment options for PACS include observation or LPI. In the ZAP study, LPI halved the risk of new angle closure disease (defined as raised IOP and/or new PAS) at 6 years but the rate was low, even in untreated eyes, and there were no cases of glaucoma. The number needed to treat (NNT) to prevent one case of raised IOP and/or new PAS was 44 over 6 years. Similarly, in the ANA-LIS trial, the overall progression rate to PAC or PACG was very low and untreated PACS eyes had twice the risk of developing endpoints, mostly PAS, over 5 years. The NNT benefit of prophylactic LPI for PAC and/ or PACG in the ANA-LIS study was 22 patients to prevent a single endpoint in 1 patient over 5 years.
LPI is not needed for all PACS but is recommended for people with PACS and additional risk factors, including high hypermetropia, family history of angle closure glaucoma, conditions requiring pupil dilation due to the risk of precipitating acute angle closure, use of anticholinergic medications, vulnerable adults who may not report symptoms of angle closure, people with only one eye or those living in remote areas without access to urgent eye care. Patients with untreated PACS should be advised to have regular eye examinations and avoid pharmacologic pupil dilatation. Information should be provided about symptoms of acute angle closure with advice given to seek prompt attention should they occur. Following LPI, it is important to repeat gonioscopy and reevaluate the angle. Persistence of ITC after LPI may be useful to risk stratify patients. Gonioscopy should be repeated in phakic patients even after LPI since the angle will progressively narrow with age-related enlargement of the lens.

II.2.4.1.2 Primary angle closure (PAC)

Treatment:
Treatment options for PAC include LPI, or for high-risk PAC, lens extraction. The EAGLE study showed lens extraction was superior to LPI for patients ≥50 years with high- risk PAC (IOP ≥30 mmHg) or PACG. There is no good quality evidence regarding the optimal initial treatment for young patients with PAC or with PAC and IOP <30 mmHg without symptomatic cataract, however, LPI +/- medication is likely the best option. The decision whether to recommend clear lens extraction for PAC should be based on the estimated risk of vision-threatening angle closure versus the risks of surgery. The risk of complications from intraocular surgery is higher in eyes with short axial length (AL), especially when AL ≤20 mm (e.g. aqueous misdirection, capsular rupture). There is an increased lifetime risk of retinal detachment with lens extraction in young patients. The impact of surgery on quality of life should also be considered, including loss of accommodation.

The Guidelines project was entirely supported by the European Glaucoma Society Foundation

Br J Ophthalmol: first published as 10.1136/bjophthalmol-2025-egsguidelines on 8 September 2025. Downloaded from http://bjo.bmj.com/ on September 29, 2025 by guest.
Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

II.2.4.1.3 Primary angle closure glaucoma (PACG)

Treatment:
If there is symptomatic cataract, prompt cataract surgery is recommended. Removal of the lens will resolve pupil block and if angle closure is appositional reverse ITC. The addition of goniosynechialysis (GSL) has no benefit compared to phacoemulsification alone. If there is PACG and no symptomatic cataract, clear lens extraction should be considered, particularly for patients ≥50 years of age. LPI is an alternative option with a lower procedure-related risk compared to lens extraction, but is likely to be less effective, particularly if there has been prolonged ITC or where there is PAS. Patients with PACG treated with LPI are likely to require continued topical medications for IOP control. Laser peripheral iridoplasty has been suggested for eyes with persistent appositional ITC after LPI, however there is insufficient evidence to recommend. The medical treatment of PACG is similar to POAG with prostaglandin analogues typically first line. Miotics can be used but are not usually tolerated long-term due to their side effects. The angle typically widens after phacoemulsificationemulsification making placement of trabecular MIGS devices technically possible; there is limited evidence of efficacy. See Fc X, Fc XI and Fc XII.

Natural history after phacoemulsification: Once phacoemulsification has been performed, if the angle is open, management is similar to that of POAG. However, if subsequent filtration surgery is considered, the axial length should guide assessment of risk.

Primary Angle Closure and Risk
In PACS, high risk may refer to an increased likelihood of acute angle closure due to factors as frequent pupil dilation or the use of antidepressant medications. In PACG, high risk might indicate a greater chance of visual disability, influenced by factors such as younger age, advanced disease, or high IOP.

The Guidelines project was entirely supported by the European Glaucoma Society Foundation

Br J Ophthalmol: first published as 10.1136/bjophthalmol-2025-egsguidelines on 8 September 2025. Downloaded from http://bjo.bmj.com/ on September 29, 2025 by guest.
Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

II.2.4.1.4 Acute angle closure (AAC)

Acute angle closure is an emergency. If an acute attack is identified and treated promptly there may be no permanent visual sequelae, however, treatment delay can lead to devastating visual loss within a short period.

Aetiology/mechanism:
In some cases, iridotrabecular contact can lead to a profound reduction in aqueous outflow and acute IOP elevation to very high levels, e.g. up to 50-70 mmHg. Increased resistance to transpupillary aqueous flow due to increased contact between the iris and the lens probably results from a mid-dilated pupil with co-activation of both sphincter and dilator muscles. This may occur in response to physiological stimuli, e.g. low light levels, or pharmacological. Pupillary block is the most common mechanism, but it is crucial to exclude secondary causes of angle closure (e.g., plateau iris, aqueous misdirection). Whilst pupil-block is treated with pilocarpine, lens-induced and retro-lenticular causes of acute angle closure should be treated with cycloplegia (e.g. atropine, tropicamide or cyclopentolate) and may be worsened by pilocarpine. Typically AAC will not resolve spontaneously.

Features:
- Ocular pain and frontal headache
- Decreased visual acuity, blurred vision, 'haloes' around lights
- Variable 'vagal' systemic symptoms (nausea and vomiting, abdominal cramps, bradycardia or arrhythmia)
- Venous congestion and ciliary injection
- Markedly high IOP
- Corneal oedema, initially mostly epithelial
- Pupil mid-dilated and reduced reactivity to light (+/iris atrophy)
- Shallow peripheral anterior chamber (with iris bombé if pupil block mechanism)
- Gonioscopy showing extensive ITC (may be difficult to visualise initially due to corneal oedema)
- Gonioscopy of fellow eye typically showing eye at risk of acute angle closure
- Glaucomflecken - anterior subcapsular grey-white fleck like opacities due to punctate necrosis of the lens epithelium
- Fundus: the disc may be normal or show glaucomatous excavation; there may be disc oedema with venous congestion and retinal haemorrhages

Treatment:
Examine the patient and take a focused history to exclude secondary, lens-induced or retro-lenticular causes. As a high proportion of acute angle closure episodes are precipitated by either topical or systemic medications, it is essential to take a thorough history of prescription and non-prescription medications and determine any medication allergies. Topical and systemic medication should be given to lower IOP and help clear the cornea. See Fc XIII.

The Guidelines project was entirely supported by the European Glaucoma Society Foundation

Br J Ophthalmol: first published as 10.1136/bjophthalmol-2025-egsguidelines on 8 September 2025. Downloaded from http://bjo.bmj.com/ on September 29, 2025 by guest.
Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

Systemic medication

A: Immediate acetazolamide is recommended if IOP ≥ 40 mmHg, preferably intravenously (Intravenous 10 mg/kg) if the patient is vomiting or when rapid onset of action is required. Acetazolamide reduces aqueous production. It should be avoided if there is a history of allergy to sulphonamides or if the patient has severe kidney disease. Potential serious side effects of acetazolamide, particularly in systemically unstable patients, include hypokalaemia, metabolic acidosis and dyspnoea. Stevens-Johnson syndrome has also been reported but is extremely rare.

B: Intravenous mannitol (0.5 to 1.5g/kg body weight as a 15% or 20% solution delivered intravenously at 3 to 5 mL/minute) can be considered if there is an inadequate response to acetazolamide. Mannitol lowers IOP through its hyperosmotic effects leading to dehydration of the vitreous body. Patients must be evaluated for heart or kidney disease because hyperosmotics increase blood volume which increases the load in the heart. This may lead to serious systemic risks in some patients, including dehydration, fluid overload, pulmonary oedema, heart failure, electrolyte imbalance, acute kidney injury and subdural haematomas. It is essential to consider the systemic risks of mannitol, and it is not advisable to administer it repeteadly.

Topical medication

Immediate treatment of AAC should include topical IOP lowering medications with aqueous suppressants preferrable. Prostaglandin analogues have a slower onset of action and are less useful in the acute setting. If pupil block is suspected topical pilocarpine 2% should be given. Pilocarpine may be ineffective if IOP is markedly raised, or the iris is ischaemic so should be deferred until IOP is reduced if presenting IOP is ≥40 mmHg. Pupil constriction tends to occur only when IOP has been lowered. Miotics in large doses can cause systemic side effects including abdominal spasms and sweating; therefore intensive use of pilocarpine should be avoided. Pilocarpine can also cause forward movement of the iris-lens diaphragm, further shallowing the anterior chamber and is contraindicated in lens-induced and retro-lenticular mechanisms of angle closure. In these eyes, cycloplegia rather than miotics, is indicated. Intensive topical steroid e.g., 6 times per day is recommended to reduce inflammation.

Laser and surgical treatment

A: Laser peripheral iridotomy (LPI)

LPI should be performed as soon as the cornea is sufficiently clear. LPI is firmly indicated in the fellow eyes if they are phakic, ideally at the time of treatment of the acute attack and before discharge. If there is insufficient response to medical treatment and LPI, or if IOP remains high and LPI is not possible due to persistent corneal oedema, surgical iridectomy or cyclodiode laser can be considered.

B: Laser peripheral iridoplasty

Iridoplasty may also be used an early intervention for acute angle closure and can break an acute attack as swiftly as medical therapy. Iridoplasty has greater penetration of an oedematous cornea compared to LPI and is an option for when there is persistent corneal oedema preventing LPI or if medical therapy has not lowered IOP quickly (e.g. with 1-2 hours). If iridoplasty is successful in breaking the acute attack, LPI is still required once the cornea has cleared.

The Guidelines project was entirely supported by the European Glaucoma Society Foundation

Br J Ophthalmol: first published as 10.1136/bjophthalmol-2025-egsguidelines on 8 September 2025. Downloaded from http://bjo.bmj.com/ on September 29, 2025 by guest. Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

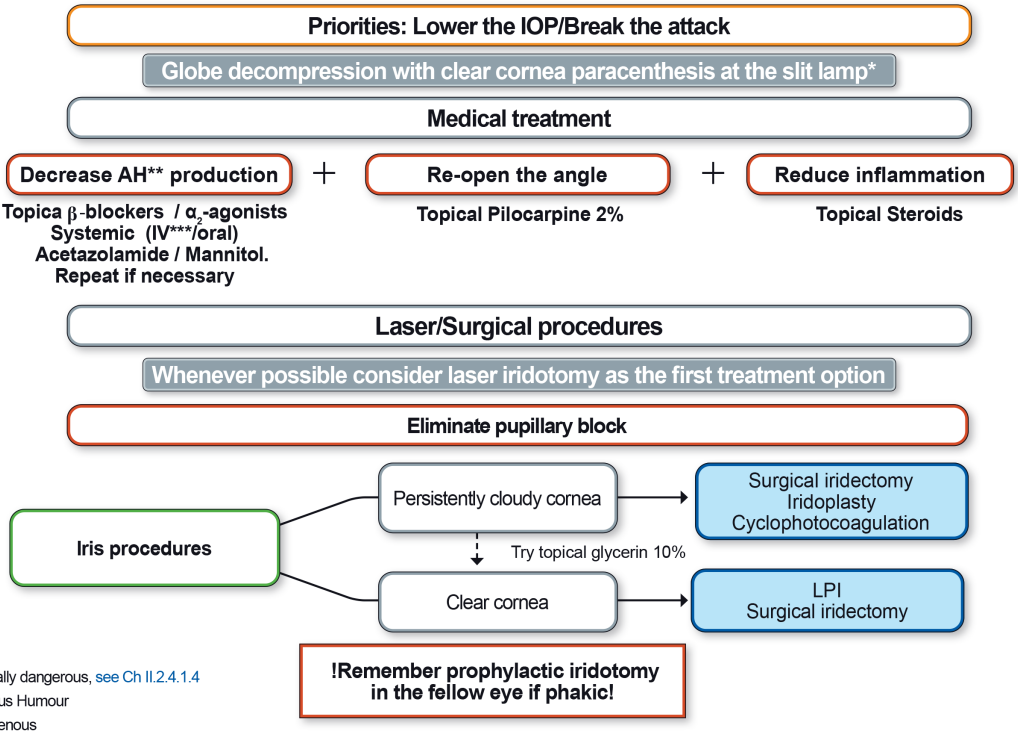
C: Anterior chamber paracentesis for globe decompression

Paracentesis is an option to immediately lower IOP and break an acute attack, especially in cases refractory to medical therapy or where there is no access to laser. Experienced ophthalmologists can perform paracentesis at the slit lamp, requiring caution since such eyes usually have extremely shallow AC. Complications include excessive shallowing of the anterior chamber, puncture of the iris or lens and suprachoroidal haemorrhage, the latter due to a too rapid decompression of the globe.

The IOP-lowering benefit may quickly wear off and anti-glaucoma medications are necessary to maintain IOP control.

Paracentesis will not resolve pupil block directly but can allow the cornea to clear rapidly and sufficiently for for LPI.

FC XIII Management of acute primary angle closure attack



* Potentially dangerous, see Ch II.2.4.1.4

** Aqueous Humour

*** Intravenous

© European Glaucoma Society

The Guidelines project was entirely supported by the European Glaucoma Society Foundation

Br J Ophthalmol: first published as 10.1136/bjophthalmol-2025-egsguidelines on 8 September 2025. Downloaded from http://bjo.bmj.com/ on September 29, 2025 by guest.
Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

D: Lens extraction
After breaking the acute attack, early lens extraction should be considered as soon as the eye is quiet, particularly in cases of high IOP, and persistent ITC after LPI. If all fails lens extraction can also be performed to break an acute attack. If there is corneal oedema, debridement of the epithelium can improve the surgical view. Intraocular surgery in eyes with very high IOP though carries a risk of suprachoroidal haemorrhage due to sudden decompression.
Phacoemulsification following acute angle closure is generally challenging due to the shallow AC, large lens, corneal oedema, poorly dilated pupil, frequent posterior synechiae, lower corneal endothelial cell counts and weaker zonules. It is useful to perform biometry (e.g. axial length, AC depth) following acute angle closure to better understand the anatomical predisposition contributing to the acute attack and gauge the risk of surgery. Eyes with previous acute angle closure undergoing cataract surgery have a higher rate of complications including aqueous misdirection, refractive surprise and corneal decompensation.

E: Glaucoma surgery
Phacoemulsification is recommended as initial surgical treatment for PACG, however, though lens extraction can reverse ITC and restore normal IOP, aqueous outflow may be permanently reduced by PAS or non-synechial damage to the TM. Long term IOP lowering medication may be required even after lens extraction and in some further glaucoma surgery is needed. Trabeculectomy or phacoemulsification-trabeculectomy can be considered in severe disease. Caution should be taken with bleb-forming procedures in eyes with short axial length. Cyclophotocoagulation is also a useful option.

Systematic review:
- Ong AY, McCann P, Perera SA, Lim F, Ng SM, Friedman DS, Chang D. Lens extraction versus laser peripheral iridotomy for acute primary angle closure. Cochrane Database of Systematic Reviews 2023, Issue 3. Art. No.: CD015116. DOI: 10.1002/14651858.CD015116.pub2.

II.2.4.1.5 Status post-acute angle closure

After acute angle closure the following signs may be present:

Features:
- Patchy iris atrophy/iris torsion/spiralling
- Posterior synechiae
- Pupil either poorly reactive or non-reactive
- Glaucomflecken
- Peripheral anterior synechiae
- Even without synechiae, the TM can be damaged with reduced outflow
- Decreased corneal endothelial cell count
- Zonules are often weak
- The disc may become pale but flat, suggesting an anterior ischaemic optic neuropathy, or it can show the typical glaucomatous optic disc neuroretinal rim loss.

In case of lens extraction, precautions and risks are as listed above in Ch II.2.4.1-2-3-4.

The Guidelines project was entirely supported by the European Glaucoma Society Foundation

Br J Ophthalmol: first published as 10.1136/bjophthalmol-2025-egsguidelines on 8 September 2025. Downloaded from http://bjo.bmj.com/ on September 29, 2025 by guest.
Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

Pharmacological mydriasis and systemic drugs with effects on the angle

Systemic drugs

Systemic drugs that may induce acute angle closure include nebulised bronchodilators (ipratropium bromide and/or salbutamol), selective serotonin re-uptake inhibitors, tricyclic antidepressants, muscle relaxants, illegal stimulant drugs, and other agents with a parasympatholytic and sympathomimetic action. Pharmacologically induced angle closure normally occurs in anatomically predisposed eyes (e.g. shallow anterior chamber). Topiramate and sulfonamides can cause acute angle closure due to peripheral uveal effusion causing a posterior pushing mechanism. Acute angle closure can also occur during or after general anaesthesia.

Pharmacological mydriasis

Acute angle closure may occur secondary to pharmacological pupil dilation, however, in the overall population it is generally safe. The risk of missing sight- threatening retinal conditions because of inadequate fundal examination through undilated pupils far outweighs the risk of precipitating angle closure induced by diagnostic mydriasis. However, people undergoing pupil dilatation should be advised to seek eye care urgently in case of symptoms e.g. eye pain. Pupil dilation is usually safe in patients with a known diagnosis of angle closure who have had appropriate prophylactic treatment (e.g. in the presence of a patent iridotomy). Pilocarpine should not be used to preventively re-constrict the pupil after dilation as it may immobilize the pupil in a mid-dilated position, increasing the risk of angle closure.

Pandit RJ, Taylor R. Diabet Med. 2000 Oct;17(10):693-9. Mydriasis and glaucoma: exploding the myth. A systematic review.

The Guidelines project was entirely supported by the European Glaucoma Society Foundation

Br J Ophthalmol: first published as 10.1136/bjophthalmol-2025-egsguidelines on 8 September 2025. Downloaded from http://bjo.bmj.com/ on September 29, 2025 by guest.
Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

II.2.5 Secondary angle closure

There are many different causes of secondary angle closure, and the clinical signs vary according to the underlying condition.

II.2.5.1 Secondary angle closure with pupil block

Aetiology/mechanism:
Pupil block pushes the iris forward to occlude the angle. In iritis or iridocyclitis, the development of posterior synechiae may lead to seclusion of the pupil and absolute pupillary block with consequent iris bombé. Acute secondary angle closure may result.
The following is a limited list of other aetiologies for relative or absolute pupil block:
- Enlarged, swollen lens (cataract, traumatic cataract)
- Anterior lens dislocation (trauma, zonular laxity, Weill-Marchesani syndrome, Marfan's syndrome etc.)
- Protruding vitreous face or intravitreal silicone oil in aphakia
- Microspherophakia
- Miotic-induced pupillary block (also the lens moves forward)
- IOL-induced pupillary block; anterior chamber IOL, phakic intraocular lens, anteriorly dislocated posterior chamber IOL

Treatment:
Several steps may be considered according to causative mechanisms:
- Topical and systemic IOP lowering medication (not sufficient on its own)
- Topical steroids in case of inflammation
- Nd:YAG LPI
- Peripheral surgical iridectomy
- Lens extraction, vitrectomy
- Discontinuing miotics in miotic-induced pupillary block
- Pupillary dilatation
- Nd:YAG laser synechiolysis of posterior synechiae

II.2.5.2 Secondary angle closure with anterior "pulling" mechanism synechial closure without pupillary block

Aetiology/mechanism:
The TM is obstructed by iris tissue or a membrane. The iris and/or a membrane are progressively pulled forward to occlude the angle.

The Guidelines project was entirely supported by the European Glaucoma Society Foundation

Br J Ophthalmol: first published as 10.1136/bjophthalmol-2025-egsguidelines on 8 September 2025. Downloaded from http://bjo.bmj.com/ on September 29, 2025 by guest.
Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

II.2.5.2.1 Neovascular glaucoma

The iridotrabecular fibrovascular membrane is induced by ocular microvascular disease with retinal ischemia; initially the neovascular membrane covers the angle, causing a secondary form of OAG, then it contracts, causing synechial angle closure.

Treatment:
For the underlying disease/retinal ischemia
- Anti-vascular endothelial growth factor (VEGF)
- Retinal ablation with laser or cryoprobe

For raised IOP
- Topical steroid to reduce inflammation
- Topical and systemic IOP lowering medication
- Topical cycloplegic
- **Long-tube aqueous drainage devices are generally implanted when incisional surgery is considered**
- Filtering procedure with antimetabolites, with relatively good prognosis if neovascularisation process is successfully treated and quiescent
- Cyclodestructive procedures
- Miotics are contraindicated

Systematic review:
- Simha A, Aziz K, Braganza A, et Al. Anti-vascular endothelial growth factor for neo-vascular glaucoma. Cochrane Database of Syst Rev 2020 Feb 6;2(2):CD007920.

II.2.5.2.2 Iridocorneal endothelial syndrome

Iridocorneal endothelial (ICE) syndrome, with progressive endothelial membrane formation and progressive iridotrabecular adhesion. Typically the PAS are patchy, very anterior, with areas of TM apparently normal. There are different presentations of ICE syndrome according to the involvement of the anterior segment structures. ICE syndrome is unilateral, more common in middle-aged women.

Treatment:
- Topical and systemic IOP lowering medications as needed
- Filtering procedure, with antimetabolite, has limited success
- Long-tube aqueous drainage device

The Guidelines project was entirely supported by the European Glaucoma Society Foundation

Br J Ophthalmol: first published as 10.1136/bjophthalmol-2025-egsguidelines on 8 September 2025. Downloaded from http://bjo.bmj.com/ on September 29, 2025 by guest.
Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

II.2.5.2.3 Epithelial and fibrous ingrowth after anterior segment surgery or penetrating trauma

Epithelial and fibrous ingrowth after anterior segment surgery or penetrating trauma may lead to the formation of an inflammatory membrane.

Treatment:
- Topical and systemic IOP lowering medication as needed
- Excision, destruction of the immigrated tissue
- Filtering procedure, with antimetabolite, has limited success
- Aqueous drainage device
- Cyclodestruction

II.2.5.2.4 Aqueous misdirection or malignant glaucoma

Aetiology/mechanism:
Aqueous misdirection is a rare type of secondary angle closure most commonly encountered after filtering surgery in eyes with PACG. It may occur after any type of intraocular surgery. Typically it occurs after surgery involving shallowing of the anterior chamber in eyes at risk, e.g. after trabeculectomy or lens extraction. Forward movement of the lens iris diaphragm causes angle closure resulting in IOP elevation. Risk factors include small eyes (axial length <21 mm), higher hypermetropic refraction (>+6 D) and PACG. Choroidal expansion and resistance to flow of fluid from the posterior to the anterior segment leads to possible aqueous accumulating posteriorly in the vitreous causing forward displacement of the irido-lens diaphragm and closure of the anterior chamber angle.

Treatment:
Medical treatment
- Parasympatholytics (atropine or cyclopentolate)
- Aqueous production suppressants given orally and/or topically
- Hyperosmotics
- Miotics are contraindicated

Surgical treatment
- A patent peripheral iridotomy must be present. If not present, LPI should be performed
- Phakic: pars plana vitrectomy with or without lens extraction
- Pseudophakic: Nd:YAG laser vitreolysis/capsulotomy may be tried
- Pseudophakic: Zonulo-hyaloido-vitrectomy can be performed using an anterior approach through a peripheral iridectomy
- Diode laser cyclophotocoagulation can be considered at any time

See Fc X-XI-XII

The Guidelines project was entirely supported by the European Glaucoma Society Foundation

Br J Ophthalmol: first published as 10.1136/bjophthalmol-2025-egsguidelines on 8 September 2025. Downloaded from http://bjo.bmj.com/ on September 29, 2025 by guest.
Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

II.2.5.2.5 Iris and ciliary body cysts, intraocular tumours

Treatment:
- Tumour irradiation or excision
- Filtering surgery only after the tumour is controlled
- Cyclodestruction

II.2.5.2.6 Silicone oil or other tamponading fluids or gas implanted in the vitreous cavity

Treatment:
- Topical/systemic IOP lowering medications as needed
- Topical steroids in case of inflammation
- Inferior iridectomy
- Silicone oil or gas aspiration
- Filtering surgery
- Long–tube drainage device
- Cyclodestruction

II.2.5.2.7 Uveal effusion

Aetiology/mechanism:
- Inflammation as in scleritis, uveitis, human immunodeficiency virus infection
- Increased choroidal venous pressure as in nanophthalmos, scleral buckling, panretinal photocoagulation, central retinal vein occlusion, arterio-venous communication
- Tumour
- Drug-induced

Treatment:
- Attempt to address the underlying mechanism
- Anti-inflammatory medication as needed
- Topical and systemic IOP lowering medication as needed
- Relaxation of scleral buckling; vitrectomy, sclerectomy in nanophthalmos
- Tumour excision or irradiation

The Guidelines project was entirely supported by the European Glaucoma Society Foundation

Br J Ophthalmol: first published as 10.1136/bjophthalmol-2025-egsguidelines on 8 September 2025. Downloaded from http://bjo.bmj.com/ on September 29, 2025 by guest.
Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

I.2.5.2.8 Retinopathy of prematurity (Stage V)

Features:
- Discomfort, pain, redness
- Corneal oedema
- IOP ≥21 mmHg
- Axially shallow anterior chamber

Treatment:
- Topical and systemic IOP lowering medications
- Filtering procedure with or without antimetabolite
- Long–tube drainage devices

II.2.5.2.9 Congenital anomalies associated with secondary angle closure glaucoma

These conditions are extremely variable in pathogenesis, clinical presentation and required management; an extensive discussion is outside the scope of this chapter.

Aetiology/mechanism:
Angle closure is caused by pushing forward the ciliary body and iris. Increase of volume of the posterior segment of the eye.

Examples are familial iris hypoplasia, anomalous superficial iris vessels, aniridia, Sturge-Weber syndrome, neurofibromatosis, Marfan's syndrome, Pierre Robin syndrome, homocystinuria, goniodysgenesis, Lowe's syndrome, microcornea, microspherophakia, rubella, broad thumb syndrome, persistent hyperplastic primary vitreous.

Features:
- Corneal oedema
- Axially shallow anterior chamber

> Anterior segment OCT (AS-OCT) may be used as a supplementary test e.g. for triage, but it cannot replace gonioscopy for diagnosis.
> Gonioscopy should be repeated, and the angle reassessed periodically during follow-up in all phakic patients.
> Always consider iatrogenic causes of angle closure including prescribed or over the counter medications or remedies.

The Guidelines project was entirely supported by the European Glaucoma Society Foundation

Br J Ophthalmol: first published as 10.1136/bjophthalmol-2025-egsguidelines on 8 September 2025. Downloaded from http://bjo.bmj.com/ on September 29, 2025 by guest.
Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

Br J Ophthalmol: first published as 10.1136/bjophthalmol-2025-egsguidelines on 8 September 2025. Downloaded from http://bjo.bmj.com/ on September 29, 2025 by guest.
Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

Br J Ophthalmol: first published as 10.1136/bjophthalmol-2025-egsguidelines on 8 September 2025. Downloaded from http://bjo.bmj.com/ on September 29, 2025 by guest.
Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

Part II · Chapter 3 Treatment

Br J Ophthalmol: first published as 10.1136/bjophthalmol-2025-egsguidelines on 8 September 2025. Downloaded from http://bjo.bmj.com/ on September 29, 2025 by guest.
Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

II.3 Treatment

II.3.1 General principles

The goal of care for people with, or at risk of, glaucoma is to promote their well-being and quality of life within a sustainable health care system.
Well-being and quality of life are influenced by a person's visual function, the psychological impact of having a chronic progressive sight-threatening condition and the costs and side-effects of treatments.
Costs include inconveniences to the individual and their care givers as well as the financial cost of examinations, diagnostic procedures and therapies, both to the individual and to society.
The effect of visual function on well-being and quality of life is variable: in general, early to moderate glaucoma has only a modest influence, whereas advanced visual function loss in both eyes may considerably reduce quality of life.
The only proven method of preserving visual function is to reduce the intraocular pressure (IOP).

Glaucoma is still the second leading cause of blindness in Europe. In most Western countries at least half of patients with manifest glaucoma are undiagnosed and glaucoma is often diagnosed late. A considerable percentage of glaucoma patients, estimated to be more than 10%, become blind in both eyes or encounter serious visual field loss in both eyes within their lifetime. Major risk factors for glaucoma visual disability are the severity of the disease at presentation, bilateral disease and age. A young patient with mild bilateral damage is at a much larger risk of disability in his lifetime than an 80-year- old patient with moderate unilateral disease. Thus, treatment must be individualized to the needs and rate of progression of each patient (see Figure II.3.1).
When examining an individual with glaucoma it is assumed that the pre-treatment level of IOP has damaged the optic nerve and will continue to do so. An IOP level is, therefore, identified below which further damage is considered unlikely: this is known as the 'Target IOP'. The definition of Target IOP is as follows: Target IOP is the upper limit of IOP which is considered to either prevent further damage or to slow the rate of VF deterioration sufficient to maintain the patient's vision-related QoL during their lifetime. The level of evidence for the concept of setting a Target IOP is low, but the approach is recommended. It is important to adjust the Target IOP when needed based on the rate of visual field worsening and risk of visual disability (see Figure II.3.1).
The impact of a loss of QoL resulting from glaucoma should determine target pressure, intensity of treatment and frequency of follow-up. For instance, patients with severe functional loss or younger patients with manifest disease should have more aggressive treatment and closer follow-up than patients with little or no risk, e.g., very old patients with early field loss or unilateral disease. Glaucoma suspects have an even smaller risk of visual impairment. In most patients with advanced glaucoma and reasonably long life expectancy, aggressive IOP lowering treatment is recommended. Elderly patients with significant health problems and mild glaucoma with relatively low IOP might prefer being followed without treatment. When treatment options are discussed with a patient, general health

The Guidelines project was entirely supported by the European Glaucoma Society Foundation

Br J Ophthalmol: first published as 10.1136/bjophthalmol-2025-egsguidelines on 8 September 2025. Downloaded from http://bjo.bmj.com/ on September 29, 2025 by guest.
Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

status and personal preferences must be considered and respected. It is also important to ensure that patients are able to comply and persist with therapy.

Disease progression rates differ very much between patients and types of glaucoma, from very slow to rapid. Many patients with glaucoma show no or only small deterioration despite years of follow-up, while rapid progression may occur in others, e.g. in patients with PEXG. The likely or observed rate of progression should determine target pressure, treatment intensity and frequency of follow-up (see Ch II.3.3). Determining the rate of progression is the standard in glaucoma care. In patients at high risk of losing vision- related QoL, a sufficient number of examinations is required to estimate the rate of progression. Frequent VF testing, e.g., three VF tests per year for the first two years after diagnosis, may be valuable for patients with significant disease to make it possible to identify rapidly progressing glaucoma. If clinically significant progression has not been identified in the first two years, the frequency of tests may be reduced. Such frequent testing is not required for all patients with glaucoma, e.g., elderly with mild disease in one eye and low untreated IOP. Once the progression rate has been determined, the target pressure should be re-evaluated based on the measured rate of progression and concomitant IOP values.

Currently, the only approach proven to be effective in preserving visual function is lowering IOP (See Part I and Fc VIII, IX XIV). However, some patients may experience a reduction in visual function despite IOP lowering. There is a need for effective non-IOP related medication. Neuroprotection can be defined as a therapeutic approach which aims to directly prevent neuronal damage. Several compounds have been shown to be neuroprotective in animal models of glaucoma, but none has reached yet a sufficient level of evidence to be considered effective in preserving visual function in glaucoma patients. There is some evidence that neuroprotective compounds may be beneficial for maintaining QoL.

Data from epidemiological studies have shown that some patients over-treated for systemic hypertension may be at increased risk of glaucoma and VF loss. However, there is no conclusive evidence to support the idea that adjusting treatment in an attempt to enhance ocular blood flow can improve the outcome in glaucoma patients.

The Guidelines project was entirely supported by the European Glaucoma Society Foundation

Br J Ophthalmol: first published as 10.1136/bjophthalmol-2025-egsguidelines on 8 September 2025. Downloaded from http://bjo.bmj.com/ on September 29, 2025 by guest.
Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

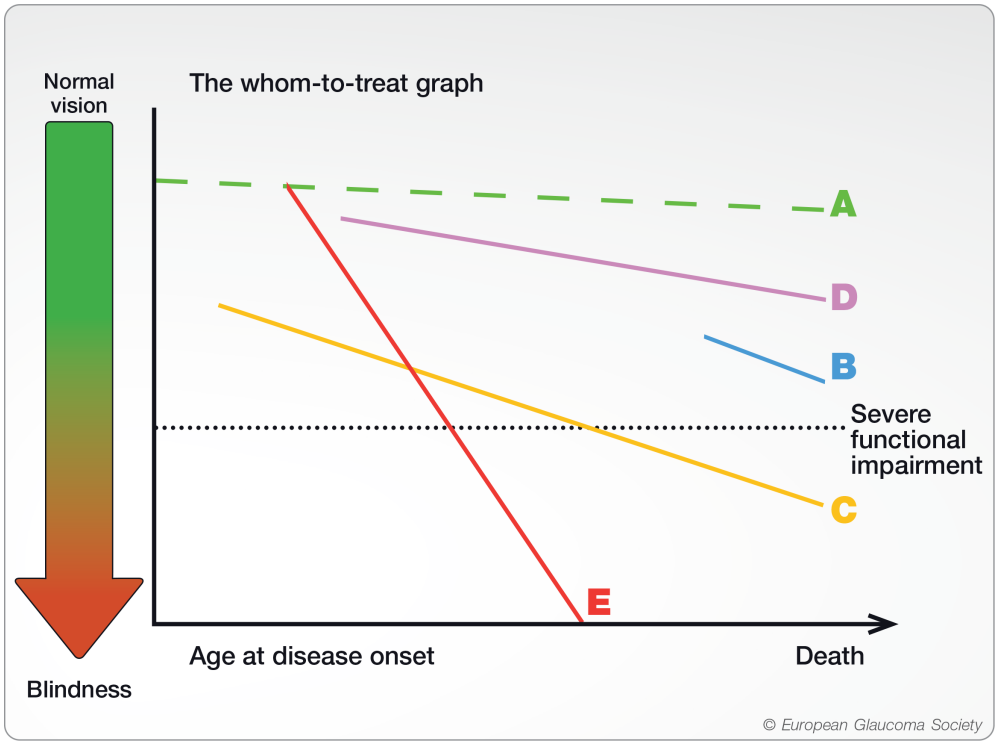


Figure II.3.1. *The whom-to-treat graph.*

The rate of ganglion cell loss and resulting functional decay is very different among different eyes. QoL is reduced when VF defects become severe. Line A represents the effect of ageing alone.
In glaucoma, loss of visual function is often much more rapid. An older patient, diagnosed late in life, with a moderate rate of progression (B) has a much lower risk of developing severe functional impairment than a younger patient with the same amount of field loss and rate of progression at diagnosis (C). A very slow rate of progression may be inconsequential for the patient and treatment may be left unchanged (D), while a rapid rate of progression (E) needs a considerably lower target pressure. The quality of life is largely determined by the VF in the better eye. On the other hand, the rate of progression of each eye separately is needed to determine the treatment.

The Guidelines project was entirely supported by the European Glaucoma Society Foundation

Br J Ophthalmol: first published as 10.1136/bjophthalmol-2025-egsguidelines on 8 September 2025. Downloaded from http://bjo.bmj.com/ on September 29, 2025 by guest. Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

The goal of glaucoma management is to promote the best possible well-being and quality of life with minimal visual disability caused by glaucoma, within a sustainable health care system. The only approach proven to be effective in preserving visual function is lowering IOP.

Overview of strategies to achieve our goal
- Identify patients with glaucoma and especially those at risk of severe visual loss.
- Identify patients at risk of developing glaucoma.
- Identify the type and mechanism of glaucoma (see Ch II.2).
- Manage and treat according to the expected rate of disease progression and risk of loss of quality of life.
- Use visual fields to quantify glaucoma stage and progression.
- In eyes at risk with a normal visual field, structural monitoring can be particularly useful to detect significant changes.
- Decrease the risk of disease progression.
- Determine the target IOP for the individual. In general, when there is more advanced damage, lower IOPs are needed to prevent further progression.

IOP lowering with medication/laser/surgery
- Verify the efficacy of treatment and reassess target IOP (see Ch II.3).
- Monitor the rate of progression (function and structure).
- Adjust management according to rate of progression and risk of visual disability.
- Assessment of the iridocorneal angle and for signs of secondary glaucoma is crucial for correct phenotyping and treatment decision.
- Always evaluate adherence to treatment and monitoring schedule.
- Audit outcomes e.g. efficacy, safety, use of resources (see Ch I.8).
- Failures include patients suffering from the consequences of insufficient IOP lowering, side effects of medications and surgical complications.

II.3.2 Treatment options

The benefits of IOP reduction both in managing glaucoma irrespective of the level of untreated IOP as well as to decrease the risk of conversion of OHT to glaucoma have been well established. Most forms of open angle glaucoma may be initially treated with topical medications or laser trabeculoplasty. Initial surgery may be considered in patients with advanced VF loss at presentation. If IOP does not match the clinical picture it is advisable to repeat the measurement. In cases with very high IOP where IOP lowering treatment is deemed necessary to be initiated on the same day, it is advisable to measure the IOP twice during the visit to ensure reproducibility.

Systematic review:

- Burr J, Azuara-Blanco A, Avenell A, Tuulonen A. Medical versus surgical interventions for open angle glaucoma. Cochrane Database Syst Rev. 2012;(9):CD004399.
- Rolim-de-Moura CR, Paranhos Jr A, Loutfi M, Burton D, Wormald R, Evans JR. Laser trabeculoplasty for open-angle glaucoma and ocular hypertension. Cochrane Database SystRev 2022 (PMID: 35943114).

The Guidelines project was entirely supported by the European Glaucoma Society Foundation

Br J Ophthalmol: first published as 10.1136/bjophthalmol-2025-egsguidelines on 8 September 2025. Downloaded from http://bjo.bmj.com/ on September 29, 2025 by guest.
Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

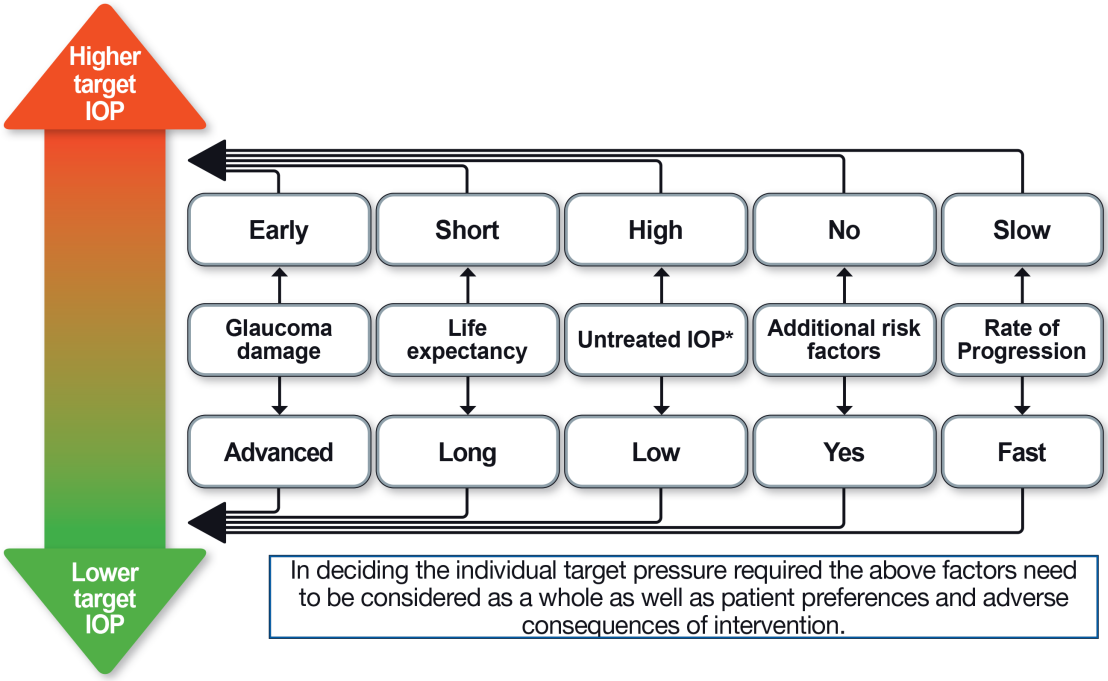
II.3.3 Target IOP

Therapy in glaucoma management aims to lower IOP to slow the VF deterioration to a rate sufficient to maintain the patient's QoL.
Target IOP is the upper limit of IOP judged to be compatible with this treatment goal. It should be re-evaluated regularly and, additionally, when progression-threatening visual disability is identified or when ocular or systemic comorbidities develop.
There is no single target IOP level that is appropriate for every patient, so the target IOP needs to be estimated for each eye of every patient (see Figure II.3.2).

II.3.3.1 Setting the Target IOP

There is little evidence to support any particular algorithm to set the target IOP.

FC XIV Target IOP decision-making factors



* Consider central corneal thickness, status of the other eye, family history, pseudoexfoliation

© European Glaucoma Society

The Guidelines project was entirely supported by the European Glaucoma Society Foundation

Br J Ophthalmol: first published as 10.1136/bjophthalmol-2025-egsguidelines on 8 September 2025. Downloaded from http://bjo.bmj.com/ on September 29, 2025 by guest.
Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

In newly diagnosed patients, the Target IOP is initially determined according to stage of disease and the baseline IOP. The treatment goal is typically estimated as a specific pressure level or a percentage reduction. In early glaucoma, an IOP of 18 to 20 mmHg with a reduction from baseline of at least 20% may be sufficient. In moderate glaucoma, an IOP of 15 to 17 mmHg with a reduction of at least 30% may be required. Lower Target IOP, e.g., 8 to 12 mmHg may be needed in more advanced disease. (See Fc XIV and XV).

Factors to consider when setting the target IOP include:

- Stage of glaucoma
  The greater the pre-existing glaucoma damage, the lower the target IOP should be
- Age and life expectancy
  Whilst younger age implies greater life expectancy and, therefore, a lower target IOP, older age is a risk factor for more rapid progression
- Untreated IOP
  A lower untreated IOP might require a lower target IOP Rate of progression during follow-up
  The faster the rate of progression, the lower the target IOP should be
- Other factors to consider: PEX, central corneal thickness, status of the other eye, family history, adverse consequences of intervention, patient preference (see Ch II.2.3.1.1 and II.3.3)

A target IOP should be set as a treatment goal at diagnosis.
Target IOP should be reviewed at each monitoring visit based on the clinical course of glaucoma or of other ocular or systemic diseases. If the target IOP has not been reached, but the glaucoma is stable, then the target IOP may be revised.
There is no single target IOP level that is appropriate for every patient, so the target IOP needs to be estimated separately for each eye of every patient and adapted to changing patient status (see I.3.2.Q.V.3.)

Greater initial VF loss is the most important predictor of blindness from glaucoma. In a newly-diagnosed patient, the RoP is unknown and target IOP is based on risk factors for progression (see Ch II.2.2.1 and Fc XIV). After sufficient follow-up and with sufficient VF tests to reliably determine the progression status, usually within 2-3 years, the RoP should be used to adjust the target IOP, taking into account IOP levels over the observation period, life expectancy, and current levels of visual function damage (See Fc XVI).

The Guidelines project was entirely supported by the European Glaucoma Society Foundation

Br J Ophthalmol: first published as 10.1136/bjophthalmol-2025-egsguidelines on 8 September 2025. Downloaded from http://bjo.bmj.com/ on September 29, 2025 by guest.
Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

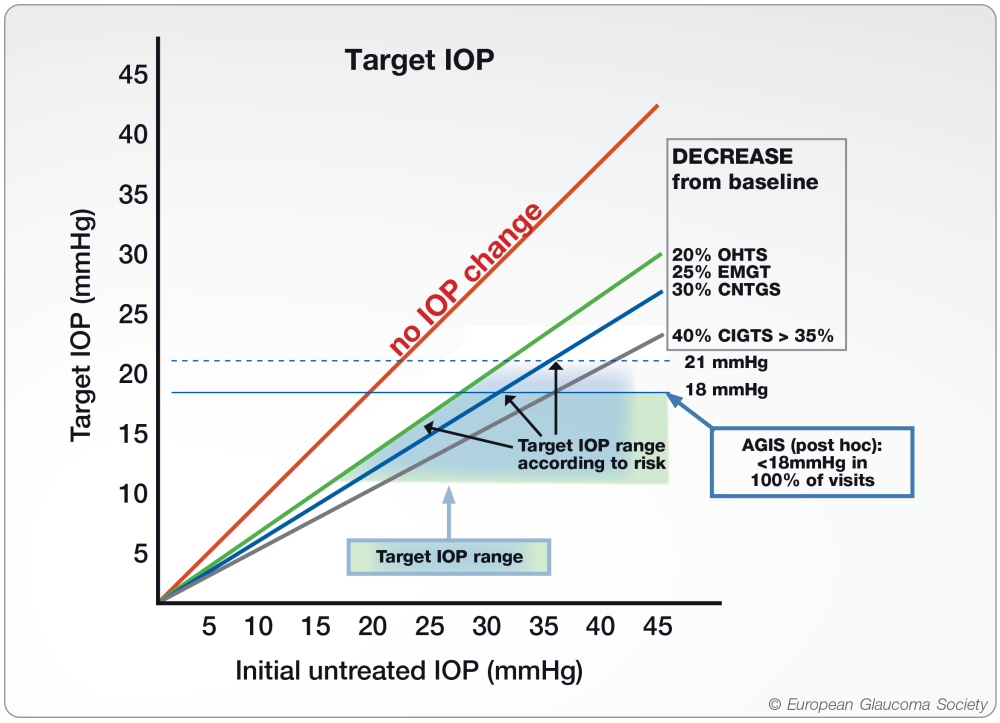


Figure II.3.2. *Diagrammatic evaluation of target IOP. The target IOP is frequently situated whitin the shaded area. The percentage IOP reduction targeted (i.e. 20%, 30%, 40%) depends mainly on VF damage at diagnosis and on rate of progression. (see also Fc XIV)*

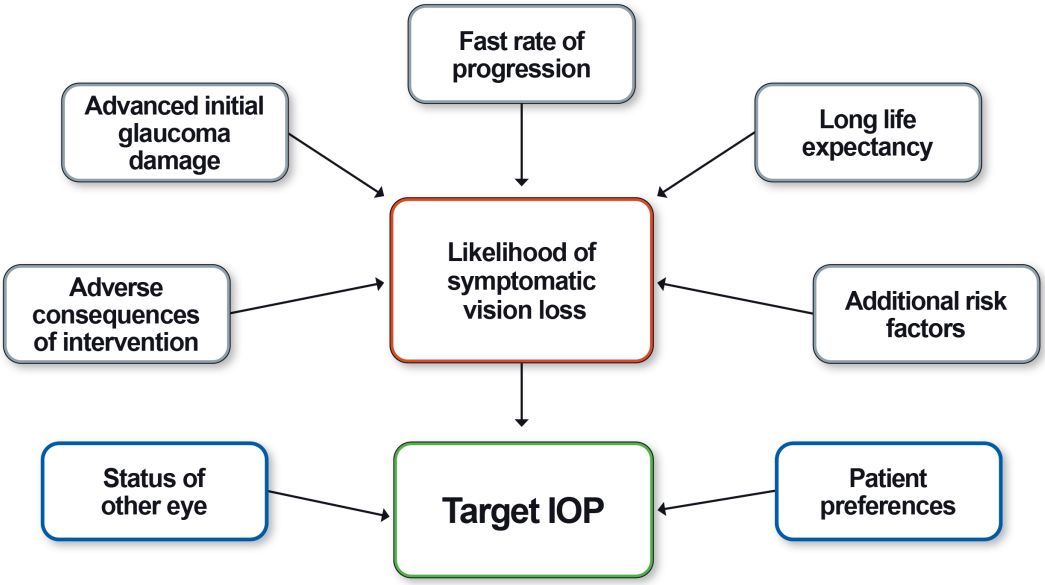
The Guidelines project was entirely supported by the European Glaucoma Society Foundation

Br J Ophthalmol: first published as 10.1136/bjophthalmol-2025-egsguidelines on 8 September 2025. Downloaded from http://bjo.bmj.com/ on September 29, 2025 by guest. Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

II.3.3.2 Achieving and re-evaluating the Target IOP

The principles of adjusting therapy to achieve treatment targets are also shown in Fcs XV and XVI. If the VF is worsening at a rate that may threaten QoL during the patient's expected lifetime, then the Target IOP should be lowered further and treatment changed. In consultation with the patient the risks and benefits of the additional intervention should be weighed. If there are sufficient VFs to estimate the rate of progression, and this rate is sufficiently slow so as not to impact on the patient's QoL, then the Target IOP may be revised upwards. If the Target IOP has not been met or if the patient is on excessive therapy or is experiencing side effects a change in treatment regimen should be planned. In case it is not yet possible to estimate the rate of progression and the Target IOP has not been met, then additional therapy should be considered.

FC XV Target IOP considerations



The treatment target is a compromise between reducing the risk of symptomatic vision loss and the consequences of therapy. Patient preferences should be taken into account.

© European Glaucoma Society

The Guidelines project was entirely supported by the European Glaucoma Society Foundation

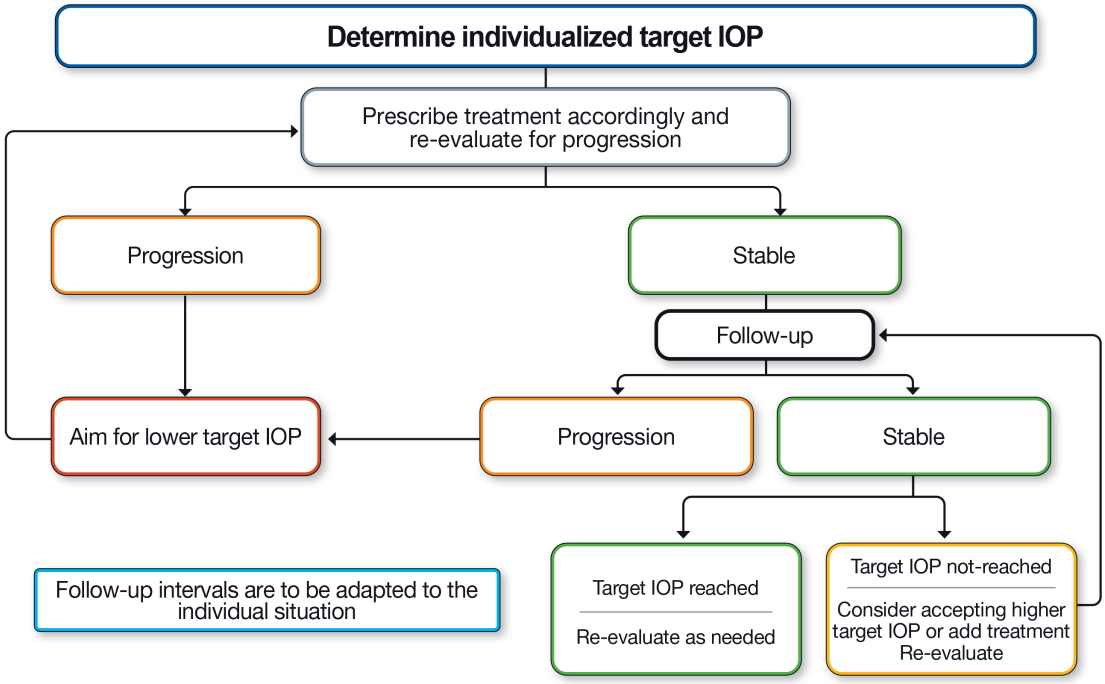
Br J Ophthalmol: first published as 10.1136/bjophthalmol-2025-egsguidelines on 8 September 2025. Downloaded from http://bjo.bmj.com/ on September 29, 2025 by guest.
Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

II.3.4 General principles of medical management

II.3.4.1 Start with monotherapy

To minimise side effects, the least amount of medication required to achieve the desired therapeutic response should be given. It is recommended to initiate the treatment with monotherapy (See Fc XVII and XVIII), except in cases with very high IOP and severe disease. Laser trabeculoplasty is also a good option for first line treatment (See chapter II.3). Treatment is considered "effective" on IOP when the IOP reduction on such treatment is comparable to the published range for that drug or that intervention in a similar population. The greatest reduction of IOP is obtained with PGAs, followed by non-selective β-blockers, Rh-kinase inhibitors, alpha-adrenergic agonists, selective β-blockers and topical carbonic anhydrase inhibitors. IOP-lowering treatment efficacy depends on untreated IOP, with larger reductions in patients with higher untreated IOP levels. Uniocular drug trials may be useful to evaluate the efficacy of topical therapy.

FC XVI Target IOP adjustment



See Ch II.3.3.2

© European Glaucoma Society

The Guidelines project was entirely supported by the European Glaucoma Society Foundation

Br J Ophthalmol: first published as 10.1136/bjophthalmol-2025-egsguidelines on 8 September 2025. Downloaded from http://bjo.bmj.com/ on September 29, 2025 by guest.
Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

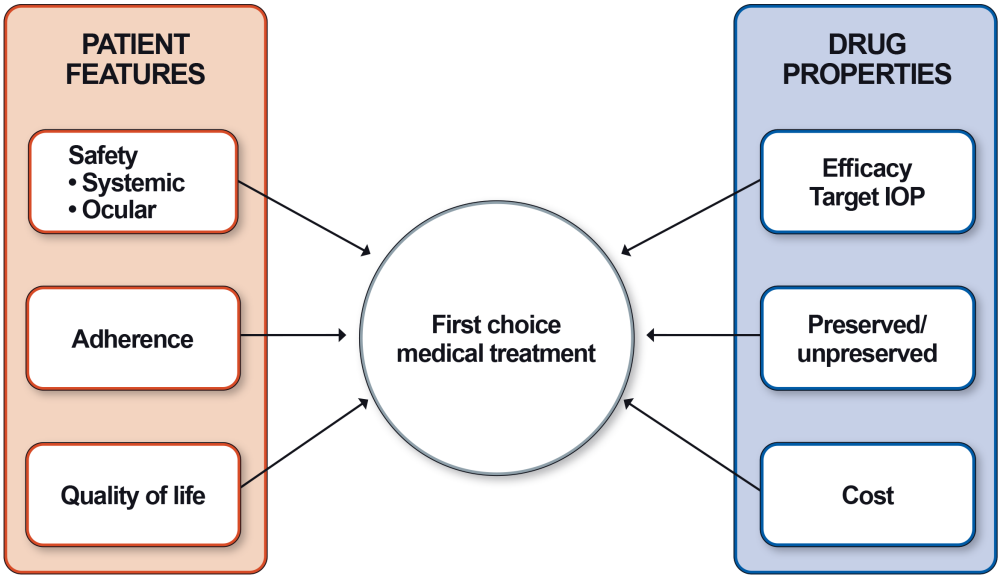
Systematic review:

– Li T, Lindsley K, Rouse B, et al. Comparative Effectiveness of First-Line Medications for Primary Open Angle Glaucoma: A Systematic Review and Network Meta-analysis. Ophthalmology. 2016;123(1):129-140.

II.3.4.2 Switch to another monotherapy

If the initial therapy is not effective or the drug is not tolerated, one should switch to another monotherapy (in the same or another class) rather than adding a second drug. Laser trabeculoplasty is an option (See Fc XVIII and Fc XIX and Fig II.3.3).

FC XVII Considerations on first choice medical treatment



A first-choice medical treatment is considered a drug that the treating physician prefers to use as initial IOP lowering therapy as opposed to the first line treatment, which is one that has been approved by policymakers.

© European Glaucoma Society

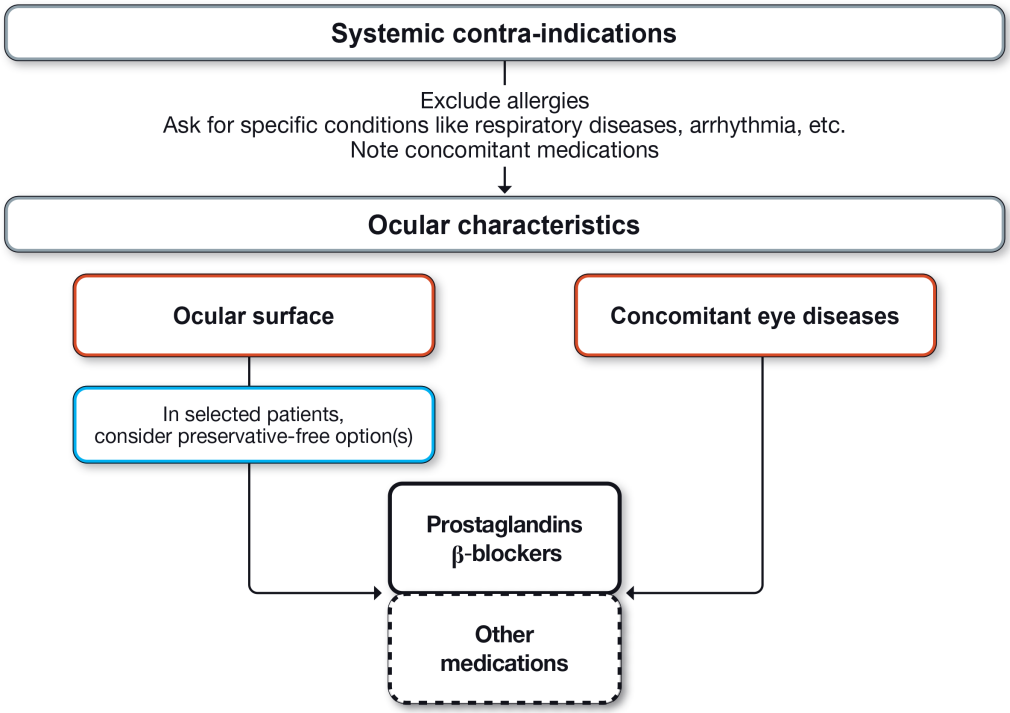
The Guidelines project was entirely supported by the European Glaucoma Society Foundation

Br J Ophthalmol: first published as 10.1136/bjophthalmol-2025-egsguidelines on 8 September 2025. Downloaded from http://bjo.bmj.com/ on September 29, 2025 by guest. Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

II.3.4.3 Add second drug / combination therapy

If monotherapy is well tolerated and effective, but has not lowered IOP to the target pressure, an additional drug of a different class should be considered. (see Tables 3.1 to 3.6). Multiple topical treatments may reduce adherence and increase exposure to preservatives. Therefore, fixed combination therapy, when available, is preferable to two separate instillations of agents. Most fixed combinations available in Europe contain a β-blocker. β-blockers may improve local tolerability of the other agent but can be associated with systemic side effects and need to be used cautiously in patients with relevant contraindications. The most frequently used combination is a PGA with a β-blocker. Other combinations include CAI with β-2 agonist and PGA with Rho-kinase inhibitor. Fixed combination formulations usually have clinical equivalence on IOP efficacy compared to the two components used separately. Combination therapy is not recommended as first choice treatment. However when target pressure is unlikely to be achieved by a single agent such as in advanced glaucoma and/or very high IOP, an initial combination formulation may be advisable.

FC XVIII Medical management – Choosing Therapy



© European Glaucoma Society

The Guidelines project was entirely supported by the European Glaucoma Society Foundation

Br J Ophthalmol: first published as 10.1136/bjophthalmol-2025-egsguidelines on 8 September 2025. Downloaded from http://bjo.bmj.com/ on September 29, 2025 by guest.
Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

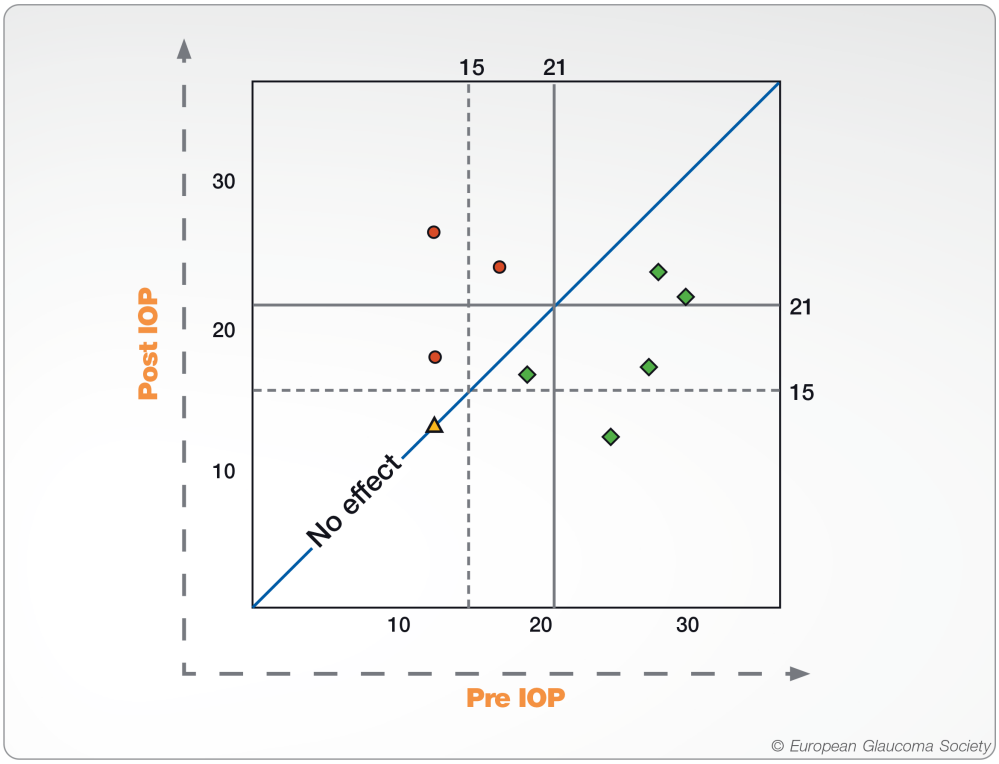


Figure II.3.3. *The pre post IOP graph. Circles in red here represent an increase of IOP from baseline. Green diamonds represent a decrease of IOP from baseline. The yellow triangle is on the 'no effect line'.*

In case of uncertainty about the IOP-lowering efficacy, consider stopping the IOPlowering medication temporarily to re-evaluate the untreated IOP.
If a patient is insufficiently controlled with two drugs then a third drug or laser trabeculoplasty or incisional surgery may be considered.
The following pages outline the most frequently used anti-glaucoma medications and emphasize their mode of action, dosage and side effects. A complete list of all possible active molecules is beyond the scope of the Guidelines. Antiglaucoma drugs have been available since 1875. The diagram in Figure II.3.4 shows a chronological summary of the introduction of topical IOP-lowering medications.
This text should be considered as a general guide, and cannot be all-inclusive. Only selected prostaglandins are approved for reduction of elevated intraocular pressure in children.

The Guidelines project was entirely supported by the European Glaucoma Society Foundation

Br J Ophthalmol: first published as 10.1136/bjophthalmol-2025-egsguidelines on 8 September 2025. Downloaded from http://bjo.bmj.com/ on September 29, 2025 by guest.
Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

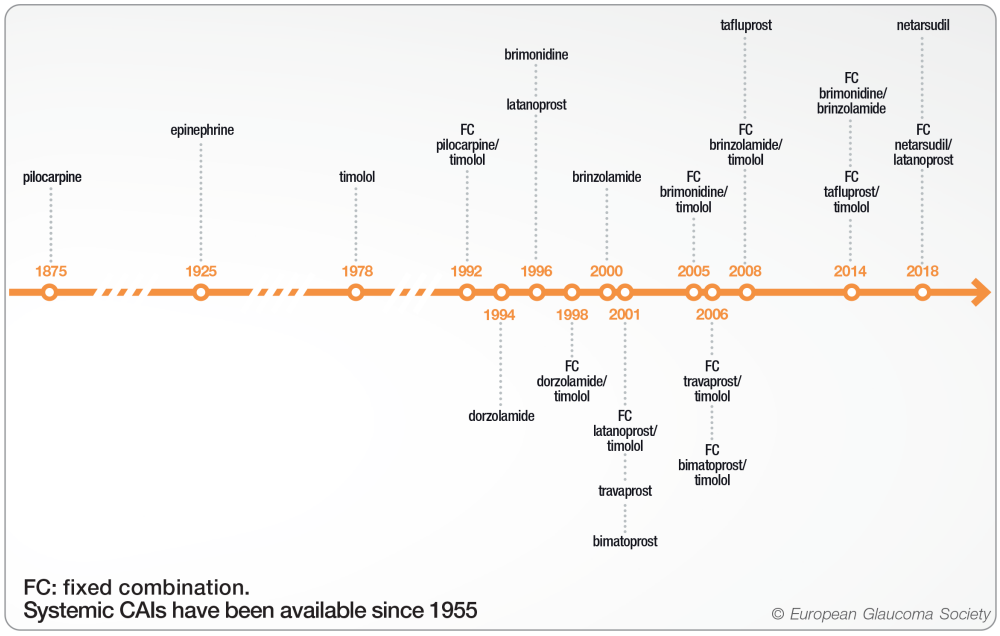


Figure II.3.4. *IOP lowering molecules and year of first clinical use.*

Br J Ophthalmol: first published as 10.1136/bjophthalmol-2025-egsguidelines on 8 September 2025. Downloaded from http://bjo.bmj.com/ on September 29, 2025 by guest. Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

The Guidelines project was entirely supported by the European Glaucoma Society Foundation

II.3.5 IOP-lowering drops

Some of the listed molecules are not yet available in Europe

Table 3.1 Class: Prostaglandin analogues and prostanoid receptor agonists

	Compound	Mode of action	IOP reduction	Potential side effects
Prosta-glandin analogues	Latanoprost 0.005% Tafluprost 0.0015% Travoprost 0.003% 0.004% Latanoprost bunod 0.024%	Increase of in uveo-scleral outflow	25-35%	**Local:** Conjunctival hyperaemia, burning stinging, foreign body sensation, itching, increased pigmentation of periocular skin, periorbital fat atrophy, eyelash changes. Increased iris pigmentation, (in green-brown, blue/grey-brown or yellow- brown irides). Cystoid macular oedema (aphakic/pseudophakic patients) with posterior lens capsule rupture or in eyes with known risk factors for macular oedema, reactivation of herpes keratitis, uveitis **Systemic:** Dyspnoea, chest pain/angina, muscle-back pain, exacerbation of asthma
Prostamide	Bimatoprost 0.03% Bimatoprost 0.01%	Increase of in uveo-scleral outflow	25-35%	
Prostanoid EP2 receptor agonist	Omidenepag isopropyl 0.002%	Increase of in uveo-scleral and trabecular outflow	≈25%	**Local:** Conjunctival hyperaemia, conjunctival hyperemia, photophobia, vision blurred, dry eye, instillation site pain, eye pain, ocular hyperemia, punctate keratitis, headache, eye, irritation, increased iris pigmentation, eyelash growth, ocular inflammation, macular oedema in aphakic/pseudophakic patients

The Guidelines project was entirely supported by the European Glaucoma Society Foundation

Br J Ophthalmol: first published as 10.1136/bjophthalmol-2025-egsguidelines on 8 September 2025. Downloaded from http://bjo.bmj.com/ on September 29, 2025 by guest. Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

Table 3.2 Class: β-receptor antagonists

	Compound	Mode of action	IOP reduction	Contra-indications	Potential side effects
Nonselective	Timolol 0.1-0.25-0.5% Levobunolol 0.25% Metipranolol 0.1-0.3% Carteolol 0.5-2.0%	Decreases aqueous humour production	20-25%	Asthma, history of chronic obstructive pulmonary disease, sinus bradycardia (< 60 beats/min), heart block, or cardiac failure	**Local:** Conjunctiva hyperaemia, superficial punctate keratitis, dry eye, corneal anesthesia, allergic blepharo-conjunctivitis **Systemic:** Bradycardia, arrhythmia, heart failure, syncope, bronchospasm, airways obstruction, distal oedema, hypotension, Hypoglycemia may be masked in Insulin dependent Diabetes Mellitus (IDDM), nocturnal systemic hypotension, depression, Erectile dysfunction
Beta-1-selective	Betaxolol 0.25 -0.5%	Decreases aqueous humour production	≈20%	Asthma, history of chronic obstructive pulmonary disease, sinus bradycardia, heart block, or cardiac– coronary failure	**Local:** Burning, stinging more pronounced than with non-selective compounds **Systemic:**Cardiac and respiratory side effects less pronounced than with non-selective compounds, depression, erectile dysfunction

The Guidelines project was entirely supported by the European Glaucoma Society Foundation

Br J Ophthalmol: first published as 10.1136/bjophthalmol-2025-egsguidelines on 8 September 2025. Downloaded from http://bjo.bmj.com/ on September 29, 2025 by guest. Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

Table 3.3 Class: Carbonic anhydrase inhibitors

	Compound	Mode of action	IOP reduction	Contra-indications	Side effects
Topical	Brinzolamide 1% Dorzolamide 2%	Decreases aqueous humour production	20%	Patients with low corneal endothelial cell count, due to increased risk of corneal oedema	**Local:** Burning, stinging, bitter taste, superficial punctate keratitis, blurred vision, tearing **Systemic:** Headache, urticaria, angioedema, pruritus, asthenia, dizziness, paresthesia and transient myopia.
Systemic	Acetazolamide	Decreases aqueous humour production	30-40%	Depressed sodium and/or potassium blood levels, cases of kidney and liver disease or dysfunction, suprarenal gland failure, hyperchloremic acidosis. Allergy to sulfamides.	**Systemic:** Paresthesias, hearing dysfunction, tinnitus, loss of appetite, taste alteration, nausea, vomiting, diarrhoea, depression, decreased libido, kidney stones, blood dyscrasias, metabolic acidosis, electrolyte imbalance

The Guidelines project was entirely supported by the European Glaucoma Society Foundation

Br J Ophthalmol: first published as 10.1136/bjophthalmol-2025-egsguidelines on 8 September 2025. Downloaded from http://bjo.bmj.com/ on September 29, 2025 by guest.
Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

Table 3.4 Class: Alpha-2 selective adrenergic agonists

	Compound	Mode of action	IOP reduction	Contra-indications	Side effects
Alpha-2-selective	Apraclonidine 0.5-1.0%	Decreases aqueous humour production	25-35%	Oral monoamine oxidase (MAO) inhibitor users Pediatric age Very low body weight in adults	**Local:** Lid retraction, conjunctival blanching, limited mydriasis (apraclonidine), allergic blepharoconjuntivitis, periocular contact dermatitis, allergy or delayed hypersensitivity (apraclonidine and clonidine >brimonidine) **Systemic:** Dry mouth and nose (apraclonidine)., fatigue, sleepiness (brimonidine)
	Brimonidine 0.2%	Decreases aqueous humour production and increases uveo- scleral outflow	18-25%		

Br J Ophthalmol: first published as 10.1136/bjophthalmol-2025-egsguidelines on 8 September 2025. Downloaded from http://bjo.bmj.com/ on September 29, 2025 by guest.
Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

The Guidelines project was entirely supported by the European Glaucoma Society Foundation

Table 3.5 Class: Rho kinase inhibitors

Compound	Mode of action	IOP reduction	Side effects
Netarsudil 0.02%	Increase trabecular outflow Reduce episcleral venous pressure	20% - 25%	**Local:** conjunctival hyperaemia, cornea verticillata, instillation site pain, conjunctival haemorrhage, instillation site erythema, corneal staining, blurred vision, increased lacrimation and erythema of eyelid **Systemic:** headache, nasal discomfort, rhinalgia, dermatitis allergic, dermatitis contact, lichenification, petechiae, polycondritis, escoriation
Ripasudil 0.4%	Increase trabecular outflow	20%	**Local:** Conjunctival hyperaemia, conjunctivitis, blepharitis, eye irritation, corneal epithelial disorder, eye pruritus, abnormal sensation in eye, eye discharge, eye pain, conjunctival follicles, intraocular pressure increased, contact dermatitis **Systemic:** gastro-intestinal disorders, dizziness, headache, nasal congestion, allergic rhinitis

The Guidelines project was entirely supported by the European Glaucoma Society Foundation

Br J Ophthalmol: first published as 10.1136/bjophthalmol-2025-egsguidelines on 8 September 2025. Downloaded from http://bjo.bmj.com/ on September 29, 2025 by guest.
Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

Table 3.6 Class: Parasympathomimetics (cholinergic drugs)

	Compound	Mode of action	IOP reduction	Contra-indications	Side effects
Direct-acting	Pilocarpine 0.5-4%	Facilitates aqueous outflow by contraction of the ciliary muscle, tension on the scleral spur and traction on the TM	20-25%	20-25% Post-operative inflammation, uveitis neovascular glaucoma. Patient at risk for retinal detachment, spastic gastrointestinal disturbances, peptic ulcer, pronounced bradycardia, hypotension, recent myocardial infarction, epilepsy, Parkinsonism	**Local:** Reduced vision due to miosis and accommodative myopia, conjunctival, hyperaemia, retinal detachment, lens opacities, precipitation of angle closure, iris cysts **Systemic:** Intestinal cramps, bronchospasm, headache
Indirect-acting	Echothiophate iodide 0.03%		15-25%		**Local and systemic:** Side effects are similar but more pronounced than with direct acting compounds

The Guidelines project was entirely supported by the European Glaucoma Society Foundation

Br J Ophthalmol: first published as 10.1136/bjophthalmol-2025-egsguidelines on 8 September 2025. Downloaded from http://bjo.bmj.com/ on September 29, 2025 by guest. Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

Table 3.7 Class: Osmotics

	Compound	Mode of action	IOP reduction	Contra-indications	Side effects
Oral	Glycerol Isosorbide	Dehydration and reduction in vitreous volume resulting in posterior movement of the iris-lens plane with deepening of the AC	15-20%	Cardiac or renal failure	Nausea, vomiting, dehydration (special caution in diabetic patients), increased diuresis, hyponatremia when severe may lead to lethargy, obtundation, seizure, coma, possible increase of glycemia, acute oliguric renal failure, hypersensitivity reaction
Intravenous	Mannitol		15-30%		

The Guidelines project was entirely supported by the European Glaucoma Society Foundation

Br J Ophthalmol: first published as 10.1136/bjophthalmol-2025-egsguidelines on 8 September 2025. Downloaded from http://bjo.bmj.com/ on September 29, 2025 by guest.
Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

II.3.5.1 Prostaglandin analogues (PGAs)

PGAs have become the first-choice therapy largely on the basis of their efficacy, as well as the practicality of once-daily dosing and of their systemic safety profile. The United Kingdom Glaucoma Treatment Study (UKGTS) has provided high level evidence for the vision-preserving effect of topical latanoprost treatment.
The primary mechanism of action of PGAs is the enhancement of uveoscleral outflow. Reduction of IOP starts approximately 2-4 h after the first administration, with the peak effect within approximately 8-12 h. PGAs may reduce short-term IOP variability compared to other classes of drugs.
While differences in efficacy among PGAs are not clinically significant, these agents provide an additive IOP lowering effect when combined with most other IOP-lowering drugs. However, two different PGAs should not be combined. Conjunctival hyperaemia, generally mild, is a common side-effect with difference in frequency and level among PGAs. Hyperaemia may decrease over time. Other PGA potential side effects are reported in Table 3.1.
Latanoprost is the only IOP-lowering agent studied in children and was shown to have a good safety profile. Consider cosmetic side effects, especially in case of unilateral treatment. Details on the mode of action, IOP lowering effect, contraindications and potential side effects of other drugs (β-blockers, carbonic anhydrase inhibitors, alpha-2 selective adrenergic agonists, Rho-kinase inhibitors) are listed in Tables II. 3.2-3.7.
See II.2.1 for paediatric cases.

II.3.5.2 Local toxicity of topical treatment: the role of preservatives

Preserved topical glaucoma medications may cause and/or exacerbate pre-existing ocular surface disease (OSD), such as dry eye and meibomian gland dysfunction, which have a high prevalence in elderly adults. Benzalkonium chloride (BAC) is the most common preservative in topical glaucoma medications. Symptoms of OSD often diminish if BAC-preserved drops are substituted with non-preserved drops. A possible unwanted effect of long-term BAC use is a reduction in the success rate of filtering surgery. Not all patients are sensitive to preservatives and not all the local side effects observed with topical IOP-lowering medications are induced by preservative.

Therapeutic options to reduce OSD include preservative-free or BAC-free medication, decreasing the number of eye drops (e.g. by using fixed combinations), treating the ocular surface with unpreserved tear substitutes and performing earlier laser or surgery. Regarding OSD, several factors have to be considered like the active compound, the specific preservative and other excipients, the ability of the patient to use single-dose preparations and the patient's ocular surface.
The European Medicines Agency (EMA) has suggested that preservatives should be avoided in patients who do not tolerate them and in those on long-term treatment.
Particular attention should be paid to glaucoma patients with pre-existing OSD or those developing dry eye or ocular irritation over time. Redness of the eyelid margin, positive corneal and conjunctival fluorescein staining or reduced tear break-up time are useful signs. Generally, preservative free treatment options should be considered if possible.

The Guidelines project was entirely supported by the European Glaucoma Society Foundation

Br J Ophthalmol: first published as 10.1136/bjophthalmol-2025-egsguidelines on 8 September 2025. Downloaded from http://bjo.bmj.com/ on September 29, 2025 by guest.
Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

II.3.5.3 Generic IOP-lowering topical medications

Many drugs are now off-patent and generic alternatives abound. By definition, a generic drug is equivalent to an on-patent drug in dosage, strength, route of administration, performance characteristics and intended use. For the purposes of drug approval, the interchangeability of a generic drug and the corresponding brand-name drug is based on the criterion of 'essential similarity'. With systemic drugs, bioequivalence studies are performed using blood samples to determine whether the plasma concentration equals within certain limits that of the on-patent drug. Large clinical studies are usually not required for approval of generic drugs in ophthalmology, and a ±10% difference between the concentration of the active compound between the generic and the branded products is considered acceptable by the EMA. Whereas the active compound is assumed to be equal, the excipients can vary considerably. This is an important issue because different adjuvants may alter the viscosity, osmolarity and pH of the eye drops. There are differences concerning the drop size, the body of the bottle and the bottle tips. Moreover in some countries no regulations exist in the choice of preservative in generic variants. These inactive compounds may therefore have an impact on tolerability and corneal penetration and should be considered. Closer monitoring of patients may be required after switching topical treatment.

Systematic reviews:

- Hedengran A, Steensberg AT, Virgili G, et al. Efficacy and safety evaluation of benzalkonium chloride preserved eye-drops compared with alternatively preserved and preservativefree eye-drops in the treatment of glaucoma: a systematic review and meta-analysis. Br J Ophthalmol 2020.
- Steensberg AT, Müllertz OO, Virgili G, et al. Evaluation of Generic versus Original Prostaglandin Analogues in the Treatment of Glaucoma: A Systematic Review and MetaAnalysis. Ophthalmology Glaucoma 2020;3:51–59.

II.3.6 Dietary supplementation, alternative therapies

At the present time there is no evidence to support that dietary supplementation or cannabinoids have a place in glaucoma management.

Systematic review:

- Whiting PF, Wolff RF, Deshpande S, et al. Cannabinoids for Medical Use: A Systematic Review and Meta-analysis. JAMA 2015;313:2456–2473.

II.3.7 Lifestyle factors

Several lifestyle factors have been associated with the development or the deterioration of glaucoma, such as smoking, caffeine intake, alcohol consumption, nutrition, exercise, meditation etc. Both IOP-dependent and non-IOP dependent mechanisms have been implicated in these associations. While some evidence supports a potential role of lifestyle factors in the pathogenesis of glaucoma, there are many discrepancies and

The Guidelines project was entirely supported by the European Glaucoma Society Foundation

Br J Ophthalmol: first published as 10.1136/bjophthalmol-2025-egsguidelines on 8 September 2025. Downloaded from http://bjo.bmj.com/ on September 29, 2025 by guest.
Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

knowledge gaps in the literature. Therefore, the current state of knowledge does not allow for strong recommendations on lifestyle for the management of glaucoma.

Systematic review:

– Almarzouki N. Impact of Environmental Factors on Glaucoma Progression: A Systematic Review. Clin Ophthalmol. 2024 Sep 30;18:2705-2720.

II.3.8 Glaucoma management during pregnancy or breast-feeding

Regarding glaucoma treatment, the most sensitive period is the first trimester due to concerns relating to teratogenicity. Therefore, for a woman with glaucoma who is of childbearing age, who might wish to conceive, the treatment strategy before and during pregnancy should be discussed. (See table 3.8 and 3.9) and alternative options such as laser or surgery may be discussed.

The potential risks to the fetus and neonate of continuing glaucoma medications must be balanced against the risk of maternal vision loss. As IOP levels may decrease during pregnancy, temporary treatment discontinuation can be considered under strict follow- up in some patients. However, if medical treatment is necessary, the lowest effective dosage of medication should be used. With medical therapy, systemic absorption should be reduced by punctal occlusion and eyelid closure. No IOP-lowering medications are specifically approved for use during pregnancy and/or breast feeding. Some glaucoma treatments are contraindicated such as CAIs, particularly in the first trimester as they may be teratogenic. Prostaglandins increase risk of miscarriage. Brimonidine may induce apnea in infants and, therefore, must not be used in late pregnancy and during breast feeding.

Although results from animal studies of IOP-lowering medications have reported adverse effects, the overall level of evidence for the risk to pregnant women and fetus/infants is low. For beta-blockers and pilocarpine there is considerable experience and they are generally considered safe.

During breast-feeding, PGAs may be acceptable. Also, netarsurdil shows negligible systemic exposure and thus no effects on the breastfed infant are anticipated; no relevant clinical data are yet available, however. CAIs and beta-blockers may be used in nursing mothers as suggested by the American Academy of Pediatricians. These are also the first line choices in infants with congenital glaucoma when medical therapy is being considered.

There is a lack of well-controlled human studies during pregnancy. Therefore it is not possible to accurately determine the real incidence of the adverse effects, or to exclude the existence of any additional unforeseen adverse effects on the fetus.

In advanced glaucoma, the Valsalva maneuver during labor may transiently raise intraocular pressure, posing a theoretical risk to already compromised optic nerves. While evidence is limited, C-section may be considered in severe or end-stage cases after multidisciplinary discussion.

The Guidelines project was entirely supported by the European Glaucoma Society Foundation

Br J Ophthalmol: first published as 10.1136/bjophthalmol-2025-egsguidelines on 8 September 2025. Downloaded from http://bjo.bmj.com/ on September 29, 2025 by guest. Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

Table 3.8 Risks related to pregnancy as described on the product label

Pregnancy Pregnancy exposure registry	**Risk summary**	Provides "risk statements" that describe for the drug the risk of adverse developmental outcomes based on all relevant human data (literature, trials), animal data, and the drug's pharmacology. Should be an integrated summary, in some cases multiple risk statements may be needed. Information included here should interpretable by health care providers.
	Clinical considerations	– Disease-associated maternal and/or embryo/feral risk – Dose adjustment during pregnancy and postpartum – Miaternal adverse reactions – Fetal/neonatal adverse reactions – Labor or delivery
	Data	– Human – Animal
Lactation	**Risk summary**	Summarize information of the presence of a drug and/or its active metabolite(s) in human milk, effects on the breast-fed child and also on milk production
	Clinical considerations	Risk benefit counselling Data
Females and males of reproductive potential	Includes information for these populations when there are recommendations for pregnancy testing and/for contraception before, during, after drug therapy. Also if there are human or animal data suggesting effects related to fertitity (e.g., testicular or ovarian histological findings), following headings should be included: a) Pregnancy testing b) Contraception c) Infertility	

Adapted from Reproductive and Developmental Toxicology 2nd Edition, Elsevier 2017. Based on FDA Pregnacy, Lactation, and Reproductive Potential Guidance, 2014.
https://www.fda.gov/regulatory-information/search-fda-guidance-documents/pregnancy-lactation-and-reproductive- potential-labeling-human-prescription-drug-and-biological
https://www.ema.europa.eu/en/documents/scientific-guideline/guideline-risk-assessment-medicinal-products-human- reproduction-lactation-data-labelling_en.pdf

The Guidelines project was entirely supported by the European Glaucoma Society Foundation

Br J Ophthalmol: first published as 10.1136/bjophthalmol-2025-egsguidelines on 8 September 2025. Downloaded from http://bjo.bmj.com/ on September 29, 2025 by guest.
Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

Table 3.9 Potential adverse effects of IOP-lowering medications during pregnancy/ breast-feeding

	Pregnancy			Breast-feeding
	Animal Studies	Human		
		Theoretical risk	Reported cases	
Parasympathetic agents	Teratogenic	Teratogenicity Dys-regulation of pla-cental perfusion	Meningism in newborn	Seizures, fever, diaphoresis
Sympathetic agents • **brimonidine**	No significant effect	Delay in labor/uter-ine hypotony	No reported side-effects	Central nervous system depression, hypotension and apnea
Prostaglandin analogues	High incidence of miscarriage	Uterine contrac-tions	One case of miscarriage	No reported side-effects
β-blockers	Delayed foetal ossification, foetal resorption	Cardiac rhythm changes Respi-ratory	Arrhythmia and bradycardia Impaired respi-ratory control in newborns	Controversy over-concentrations in breast milk Apnea and bradycardia
Carbonic anhydrase inhibitors Topical	Teratogenicity (1st trimester)			
	Decreased weight gain Vertebral body malformation	Lower foetal weight	No reported side-effects	No reported side-effects
Rho-kinase inhibitors	Foetal loss and decrease in foetal weight at exposures considerably higher than clinically relevant dosage		Not sufficient data available	Low systemic exposure and thus no effects are anticipated No relevant clinical data are yet available
Oral	Forelimb anom-alies	Limb malforma-tions	One case of teratoma	No reported side-effects

The Guidelines project was entirely supported by the European Glaucoma Society Foundation

Br J Ophthalmol: first published as 10.1136/bjophthalmol-2025-egsguidelines on 8 September 2025. Downloaded from http://bjo.bmj.com/ on September 29, 2025 by guest. Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

II.3.9 Neuroprotection and glaucoma treatment

Neuroprotection can be defined as a 'therapeutic approach' aiming to directly prevent or significantly hinder neuronal cell damage.
There is no evidence yet to support the use of neuroprotective agents in glaucoma. Until robust well-controlled studies provide clearer evidence, the clinical relevance of neuroprotection remains uncertain. Relying on these strategies without prioritising established IOP-lowering therapies has no demonstrable benefit and should not be pursued.
Citicoline oral solution is registered as food for special medical purposes (FSMP) in 4 European countries. One RCT using QOL as the outcome investigated citicoline oral solution in the context of neuroprotection and reported some beneficial effect on QOL. in patients with glaucoma. However this RCT did not include visual field data as an outcome. Topical administration of citicoline eye drops is currently being evaluated in a large clinical trial to verify whether added to IOP-lowering treatment it may prevent visual field damage in patients with glaucoma.
Nicotinamide (vitamin B3) has also emerged as a promising candidate, with preclinical studies demonstrating retinal ganglion cell protection in animal models and early phase II trials showing encouraging results, including some studies combined with pyruvate supplementation. Oral supplementation of nicotinamide is currently being tested in large interventional trials as a neuroprotective adjuvant for glaucoma management. Care should be taken in respect to systemic side effects such as liver toxicity at high doses. Gingko biloba is used occasionally by some clinicians but should be avoided in patients receiving anticoagulants.

Systematic reviews:

- Sena DF, Lindsley K. Neuroprotection for treatment of glaucoma in adults. Cochrane Database Syst Rev 2017;1:CD006539.
- Prinz J, Prokosch V, Liu H, Walter P, Fuest M, Migliorini F. Efficacy of citicoline as a supplement in glaucoma patients: A systematic review. PLoS One. 2023 Sep 28;18(9):e0291836. doi: 10.1371/journal.pone.0291836. PMID: 37768938;

II.3.10 Practical considerations related to topical medical treatment

Once the medication is instilled into the conjunctival sac, the physiological tear turnover will cause a complete washout within 5 minutes.
When two separate drops are prescribed a minimum interval of two minutes between instillations is recommended. Blinking also may influence washout.
As drugs that are absorbed through the highly vascularised nasal mucosa avoid hepatic first-pass metabolism, this might lead to systemic side effects, particularly with beta- blockers.
Punctal obstruction may not increase the IOP-lowering efficacy of a topical drug, however it will likely reduce systemic side effects.
If the medication is prepared as a suspension, patients should be advised to shake the bottle before use.

The Guidelines project was entirely supported by the European Glaucoma Society Foundation

Br J Ophthalmol: first published as 10.1136/bjophthalmol-2025-egsguidelines on 8 September 2025. Downloaded from http://bjo.bmj.com/ on September 29, 2025 by guest.
Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

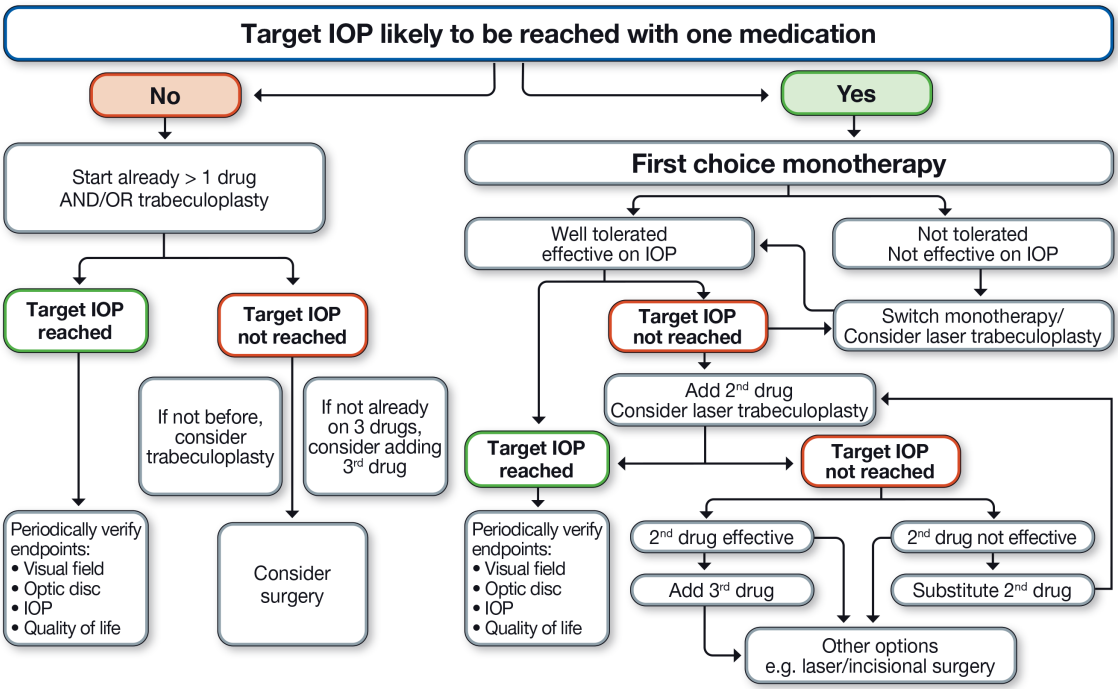
II.3.11 Adherence in glaucoma

Glaucoma is a chronic progressive disease that requires continuous long-term engagement of the patient with the recommendations proposed by the doctor.

II.3.11.1 Terminology

The commonly used term 'compliance' has been increasingly replaced in recent times by the term 'adherence'. Both are defined as the 'cooperation of the patient with the recommendations given by the doctor'. The former is more passive while the latter implies the active part of the patient. 'Persistence' is defined as the length of time during which the patient is taking the medication as prescribed.

FC XIX Treatment algorithm in glaucoma topical therapy



If poor response to several different medications, consider non-adherence

© European Glaucoma Society

The Guidelines project was entirely supported by the European Glaucoma Society Foundation

Br J Ophthalmol: first published as 10.1136/bjophthalmol-2025-egsguidelines on 8 September 2025. Downloaded from http://bjo.bmj.com/ on September 29, 2025 by guest. Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

II.3.11.2 Factors associated with non-adherence

The following factors have been described as common obstacles to glaucoma medication adherence:

- Medication per se like cost of the drugs, side effects, complicated dosing regimen
- Ocular surface disease (OSD)
- Individual/situational/environmental like a major event in the patients life, or a disordered life-style
- Forgetfulness, comorbidity, poor understanding of the disease, sex (men are more likely to be non-adherent)
- Stage of the disease (patients with less advanced disease tend to be less adherent)
- Clinician lacking communication with the patient

II.3.11.3 Identifying non-adherence

Clinicians are unable to detect non-adherence unless such information is volunteered by patients.
Non-adherence is best identified by asking how and who administers the eye drops, taking an empathetic approach and asking questions, e.g., "have you forgotten to use your eye drops during the last week?" If "yes", then ask "how many times?" Sometimes asking the patient to demonstrate their drop instillation technique is useful (See Ch I.5).

II.3.11.4 Improving adherence

Adherence may be improved by simplifying the drop regimen, with patient education, by improving communication and setting alarms/messages. For selected patients drug delivery by sustained release devices may be a future option to reduce burden of daily therapy thereby increasing compliance. Currently, a variety of these slow-release drug delivery systems are being developed but are not yet available in Europe. These include, for example, prostaglandin-releasing implantable devices, drug eluting contact lenses or conjunctival fornix inserts.

Systematic reviews:

- Waterman H, Evans JR, Gray TA, et al. Interventions for improving adherence to ocular hypotensive therapy. Cochrane Database Syst Rev 2013:CD006132.
- Ha A, Jang M, Shim SR, Kim CY, Chang IB, Kim YK. Interventions for Glaucoma Medication Adherence Improvement: A Network Meta-analysis of Randomised Controlled Trials. Ophthalmology. 2022 Nov;129(11):1294-1304. doi: 10.1016/j.ophtha.2022.06.025. Epub 2022 Aug 23. PMID: 36028393.

The Guidelines project was entirely supported by the European Glaucoma Society Foundation

Br J Ophthalmol: first published as 10.1136/bjophthalmol-2025-egsguidelines on 8 September 2025. Downloaded from http://bjo.bmj.com/ on September 29, 2025 by guest.
Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

II.3.12 Laser surgery

II.3.12.1 Laser peripheral iridotomy (LPI)

Indications:
Angle closure disease
High risk PACS, PAC, PACG
Treatment of AAC with suspected pupillary block and / or plateau iris mechanism (See Fc X, XI, XII and XIII).

Preoperative preparation:
Instil topical pilocarpine. If the cornea is oedematous, use topical glycerin 10% if available. Systemic acetazolamide, IV mannitol or oral hyperosmotic agents may be needed to clear the cornea in cases of AAC. For prevention of IOP spikes use a topical alpha-2 agonist 1 hour prior to the procedure and immediately afterwards.

Procedure:
After abundant instillation of topical anesthetic, a laser iridotomy contact lens with coupling solution is placed onto the cornea. The lens keeps the eyelids open, stabilises the eye, provides additional magnification, focuses the laser beam and acts as a heat sink.
The iridotomy should be either completely covered or fully uncovered by the upper eyelid to reduce visual symptoms. It is preferable if the site is in the superior quadrant of the iris between 11 or 1 or at 3 or at 9 o'clock, in a thinner area or crypt, in the iris periphery avoiding visible vessels.
The goal is to achieve patency with minimal total energy. Two approaches are in use: multiple (10-30) low-energy shots or fewer (2-3) but higher power shots*.
Whole thickness perforation of the iris is assumed when pigment, mixed with aqueous, flows from the posterior into the anterior chamber. Once a full thickness hole has been made, it should be enlarged to achieve an adequate size 200 micron in order to maintain patency in case of iris oedema, pigment epithelial proliferation or pupil dilation. Red reflex transillumination through the peripheral iridotomy is not a reliable indicator of patency.

Lasers parameters for Nd:YAG LPI

Power	1-6 mJ
Spot size	50-70 µm (constant for each laser model)
Pulses per burst	1-3
Recommendations	– Focus the beam within the iris stroma rather than on the surface of the iris* Avoid any apparent iris vessels – Use the least amount of energy that is effective – Lens capsule damage is possible above 2 mJ energy With most lasers less than 5 mJ per pulse is required

**start with the lowest power.*
***Pretreatment with argon laser to minimise bleeding by coagulating iris vessels is optional (spot size 400 µm, duration 0.2 sec, energy approximately 200-300 mW)*

The Guidelines project was entirely supported by the European Glaucoma Society Foundation

Br J Ophthalmol: first published as 10.1136/bjophthalmol-2025-egsguidelines on 8 September 2025. Downloaded from http://bjo.bmj.com/ on September 29, 2025 by guest. Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

In case of thick dark irides, to reduce total Nd:YAG energy, pretreatment with a thermal laser in 2 stages may be considered. In the case of Argon laser, low power of 90-250 mW, pulse duration 0.05 sec, spot size 50 µm is applied first, followed by higher power of 700 mW, pulse duration 0.1 sec, spot size 50 µm to create a punched-out crater appearance. LPI is completed with Nd:YAG laser.

Complications:

- Intraoperative complications
  - Bleeding from the iridotomy site can usually be stopped by gentle pressure applied to the eye with the laser contact lens.
  - Lens capsule damage is possible especially with higher energy.
- Postoperative complications
  - Transient IOP elevation a few hours after the procedure is the most frequent early complication.
  - Postoperative inflammation is transient and mild, rarely resulting in posterior synechiae.
  - Visual disturbances, e.g. glare, blurring, ghost images, halo, crescent are less likely to occur when the peripheral iridotomy is either completely covered by the eyelid or completely uncovered.
  - Rare complications include cystoid macular oedema, aqueous misdirection or choroidal effusion.

Postoperative management:

- Check the patency of the peripheral iridotomy immediately after treatment. Check the IOP after 1-3 hours and treat accordingly.
- Topical anti-inflammatory drops (NSAIDS or steroids) during the first week: e.g. 2 hourly steroids for 2 days followed by 4x day for 5 days - more intensively in eyes with dark irides.
- Check the angle with gonioscopy after a week or more to assess the impact of treatment on angle configuration.

II.3.12.2 Laser trabeculoplasty

Multiple forms of laser trabeculoplasty exist, including Argon laser trabeculoplasty (ALT), Selective Laser Trabeculoplasty (SLT) and other thermal effect lasers. SLT is widely used as primary treatment. Direct trans-limbal SLT has also recently been introduced.

Indications:

Lowering of IOP in POAG, PXFG, PDG and high risk OHT:

- As initial treatment (See Fc VIII)
- As an add-on or replacement treatment for reasons of efficacy, tolerability and adherence

The Guidelines project was entirely supported by the European Glaucoma Society Foundation

Br J Ophthalmol: first published as 10.1136/bjophthalmol-2025-egsguidelines on 8 September 2025. Downloaded from http://bjo.bmj.com/ on September 29, 2025 by guest.
Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

Contraindications:
- Angle closure
- Neovascular glaucoma
- Uveitic glaucoma
- Juvenile Open Angle Glaucoma
- Angle dysgenesis

Preoperative preparation:
Abundant instillation of topical anesthetic. For prevention of IOP spikes, medications to lower the IOP are recommended. Options include topical alpha-2 agonist (most commonly), pilocarpine or acetazolamide prior to or immediately after the procedure.

Procedure:
Most frequently used lasers are:
- Q-switched, short pulsed, frequency–doubled Nd:YAG (532 nm) laser SLT
- Argon continuous-wave laser (green or blue/green) ALT

Lenses:
Available types include: Goldmann-type gonioscopy lens, Ritch trabeculoplasty lens©, CGA©, Meridian©, Latina© (SLT), Magnaview©.
Identify angle landmarks and place the laser spots at the pigmented TM over 360° (in eyes with highly pigmented TM, 180° initial treatment may be considered).

Laser parameters for laser trabeculoplasty

Laser parameters	ALT	SLT
Spot size	50 µm	400 µm
Exposure	0.1 sec	3 nsec (fixed)
Power	500-1200 mW according to the reaction on the TM; with heavily pigmented TM low power is sufficient	0.4 to 1.2 mJ according to the desired reaction; in heavily pigmented TM start with low levels e.g. 0.4 mJ
Optimal reaction	Transient bleaching or small gas bubble formation	The power is titrated until the appearance of tiny air bubbles, »champagne bubbles«, at the site of the laser burn, with visible bubbles on at least 50% of shots
Number of spots	50-100 evenly spaced spots over 180-360°	c.100 non-overlapping spots spaced over 360

Complications:
- Transient elevation of IOP
- Inflammation
- PAS (after ALT)
- Corneal endothelial changes
- Transient corneal haze
- Cystoid macular oedema
- Keratitis (rare)

The Guidelines project was entirely supported by the European Glaucoma Society Foundation

Br J Ophthalmol: first published as 10.1136/bjophthalmol-2025-egsguidelines on 8 September 2025. Downloaded from http://bjo.bmj.com/ on September 29, 2025 by guest.
Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

Post-operative management:
IOP should be checked after 1-3 hours, and in high risk patients like those with advanced glaucomatous damage again within one week. Topical corticosteroids or NSAIDs may be prescribed for 4-7 days, but often are not needed. Efficacy of the treatment may be evaluated at 6-8 weeks.

Effectiveness of laser trabeculoplasty:
ALT and SLT have the same IOP lowering efficacy.
Laser trabeculoplasty is initially effective in 80 to 85% of treated eyes with a mean IOP reduction of 20 to 25% or 4 to 9 mmHg, likely to be greater for primary treatment than for those already on medication.
The effect wears off over time, for both ALT and SLT.

Repeat treatment:
If the first complete treatment is effective but the target pressure is not achieved or if the effect wears off after a period of control, a second treatment may be effective. Evidence for third or fourth retreatments is lacking.

Predictors of efficacy:
Higher baseline IOP is associated with greater IOP reduction after SLT and ALT.
ALT is less successful in eyes with no pigmentation of TM, whereas SLT effect appears to be independent of TM pigment.

Systematic reviews:
- Chi SC, Kang Y.-N, Hwang D.-K, et al. Selective laser trabeculoplasty versus medication for open-angle glaucoma: systematic review and meta-analysis of randomised clinical trials Br J Ophthalmol 2020;104:1500–1507.
- Rolim-de-Moura CR, Paranhos Jr A, Loutfi M, Burton D, Wormald R, Evans JR. Laser trabeculoplasty for open-angle glaucoma and ocular hypertension. Cochrane Database of Systematic Reviews 2022, Issue 8. Art. No.: CD003919. DOI: 10.1002/14651858.CD003919.pub3.

II.3.12.3 Thermal laser peripheral iridoplasty (TLPI)

Indication:
This may be helpful in plateau iris syndrome with remaining angle closure despite a patent peripheral iridotomy and elevated IOP, although the efficacy in reducing IOP is limited. (See Fc XII). It has also been used to break treatment-resistant Acute Angle Closure attacks. Occasionally utilized with non-penetrating filtering surgeries to prevent or treat iris incarceration.

Lasers:
Different modes and wavelengths of continuous wave lasers can be used.

The Guidelines project was entirely supported by the European Glaucoma Society Foundation

Br J Ophthalmol: first published as 10.1136/bjophthalmol-2025-egsguidelines on 8 September 2025. Downloaded from http://bjo.bmj.com/ on September 29, 2025 by guest.
Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

Preoperative preparation:
Instillation of pilocarpine. For prevention of IOP spikes use topical alpha-2 agonist prior to the procedure and immediately afterwards.

Lens:
Contact TLPI lenses.

Laser parameters for laser iridoplasty

Laser parameters [II,D]	Contraction burns of long duration, low power, large spot size
Spot size	200-500 µm
Exposure	0.3-0.6 sec
Power	200-400 mW
Location	Aiming beam should be directed at the most peripheral part of the iris
Optimal reaction	Visible contraction of the peripheral iris with flattening of the iris curvature, avoiding bubble formation or pigment release
Number of spots	20-24 spots over 360° leaving 2 spot diameters between each spot and avoiding visible radial iris vessels

Complications:
- Mild iritis
- Corneal endothelial burns
- Transient elevation of IOP
- Post-operative posterior synechiae
- Permanent pupil mid dilation
- Peripheral iris atrophy

Post-operative management:
- Topical corticosteroids or NSAIDS should be instilled for the first week
- Prevention of IOP spike as per laser trabeculoplasty
- Gonioscopy

Systematic review:
- Bayliss JM, Ng WS, Waugh N, Azuara-Blanco A. Laser peripheral iridoplasty for chronic angle closure.Cochrane Database of Systematic Reviews 2021, Issue 3. Art. No.: CD006746. DOI: 10.1002/14651858.CD006746.pub4.

The Guidelines project was entirely supported by the European Glaucoma Society Foundation

Br J Ophthalmol: first published as 10.1136/bjophthalmol-2025-egsguidelines on 8 September 2025. Downloaded from http://bjo.bmj.com/ on September 29, 2025 by guest.
Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

II.3.13 Cyclo-ablative procedures

Indications:
- When filtration surgery or glaucoma drainage devices are likely to fail, have failed, or are not feasible
- Refractory glaucomas
- Acute management of aqueous mis direction

Available technologies:
- Lasers
  - Laser delivery modes include: transscleral, endoscopic and transpupillary
  - Each technique requires the appropriate probe
    - Transscleral diode cyclophotocoagulation
    - Micropulse laser cyclophotocoagulation
    - Direct and endoscopic cyclophotocoagulation
- Ultrasound
  - High intensity focused ultrasound circular cyclo-coagulation
- Cryoprobe

Technique:

Anesthesia	Retrobulbar or peribulbar injection
Scleral transillumination	The light source is directed posterior to the limbus to identify ciliary body by transillumination. The dark demarcation line indicates the anterior margin of the ciliary body
Probe positioning, settings, applications	According to the manufacturer recommendations

Endoscopic cyclophotocoagulation:
Endoscopic techniques combined with laser technology allow the photocoagulation of ciliary processes. The approach can be limbal or through pars plana.

Transpupillary cyclophotocoagulation:
This procedure is limited to cases of aniridia, through a large surgical iridectomy or when broad anterior synechiae pull forward the iris enough to make the ciiary body visible to gonioscopy.

Complications:
- Persistent inflammation
- Hyphaema
- Corneal decompensation
- Vision loss
- Hypotony and phthisis

The Guidelines project was entirely supported by the European Glaucoma Society Foundation

Br J Ophthalmol: first published as 10.1136/bjophthalmol-2025-egsguidelines on 8 September 2025. Downloaded from http://bjo.bmj.com/ on September 29, 2025 by guest.
Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

Post-operative management:
Consider pain control. Topical corticosteroids and/or NSAIDS, and atropine as needed. In the immediate postoperative period, IOP should be monitored and the anti-glaucoma medication changed accordingly.

- LPI: Argon laser pretreatment for dark irises reduces YAG laser energy requirements
- Laser trabeculoplasty is a good option for first line treatment of OHT/POAG
- t is important to emphasise that the need for life-long follow-up remains after laser treatment
- Drainage surgery may be be prioritized over cyclo-destructive procedures in eyes with potential for useful vision

II.3.14 Incisional surgery

II.3.14.1 General principles

Indications for different techniques of incisional surgery depend on:
– the type of glaucoma
– the target IOP
– the previous history (e.g. surgery, medications, degree of VF loss)
– the risk profile (e.g. single eye, occupation, refractive status, myopia)
– the preferences and experience of the surgeon
– the patient preference, expectation and postoperative compliance
Surgery should be considered whenever medical or laser treatment is unlikely to maintain sight in the affected eye. It should not be left as a last resort (see Ch II.3.1).

Treatment options:
Glaucoma surgery can be successfully practiced in many ways. A detailed description of surgical techniques is not within the scope of this text. The ophthalmologist must assess the indications, the risks and the benefits of surgery in each individual case.
The primary goal of surgery is to reduce IOP, ideally achieving a target IOP without additional medication. Additional medications can be used if the target IOP is not reached by surgery alone. Success rates of a surgical method in terms of IOP lowering can be best evaluated in the absence of additional IOP-lowering medical treatment. Also, it is useful to count the percentage of “successes” below a defined IOP level as a scattergraph. See Fig. II.3.3.
It is important to consider not just the IOP but also complication rates and functional outcomes. Filtration surgery is a generic term used for procedures where the IOP- lowering effect is obtained by creating a passageway for the aqueous to drain into the episcleral or subconjunctival space. PCG is usually treated with surgery, likely trabeculotomy or goniotomy, or filtration surgery with antifibrotic agents. (See Ch II.2.1). Complicated glaucoma cases such as those having failed previous surgery, many types of secondary glaucoma and congenital glaucoma require tertiary care management. In addition to trabeculectomy, other types of procedure may be necessary. For repeated surgery, cyclodestructive procedures and long-tube implants are more commonly used. (See Fc VIII)

The Guidelines project was entirely supported by the European Glaucoma Society Foundation

Br J Ophthalmol: first published as 10.1136/bjophthalmol-2025-egsguidelines on 8 September 2025. Downloaded from http://bjo.bmj.com/ on September 29, 2025 by guest.
Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

II.3.14.2 Techniques

II.3.14.2.1 Penetrating glaucoma surgery

II.3.14.2.1.1 Trabeculectomy

The most widely used surgical procedure in glaucoma is trabeculectomy, which produces a 'guarded' fistula between the anterior chamber and the subconjunctival space. Modifications have been proposed including changes in size, shape and thickness of the scleral flap, dissection of limbal or fornix-based conjunctival flaps, positioning of fixed or releasable or adjustable sutures and, in order to reduce scarring and "modulate" wound healing the use of antifibrotics and other anti-scarring agents are delivered in different ways.
With the continuous refinement of the technique over the years, the long-term success rate of filtering surgery by experienced surgeons has been reported to be very high. Long-term IOP control with fewer or no medications is achieved in many cases, although some patients do require further therapy or repeat surgery.
There are however large differences in the criteria used for the definition of success and in the final success rates reported.
While there are newer options for bleb-forming procedures involving the use of an implant, trabeculectomy currently appears to be still more effective in terms of IOP reduction and seems to have a lower risk of failure, possibly due to greater flexibility in the postoperative management. The use of implants for performing filtration surgery should be weighed against the cost of the devices and the expected benefits.

Indications:
- Medications, laser or other surgeries have failed to obtain the target IOP or to stabilize the disease or are not suitable (e.g. due to non-compliance or side-effects)
- Where a target pressure is unlikely to be achievable with topical medications, lasers or other types of surgery
- In the more advanced stages of glaucoma initial surgery should be considered as a more effective primary management option than medical treatment

Risks of trabeculectomy:
- Clinically significant vision threatening consequences of hypotony may develop at any time post-operatively, such as macular folds, epiretinal gliosis and chronic choroidal detachment.
- Patients undergoing trabeculectomy should be advised on the symptoms of blebitis/endophthalmitis that include red eye, tearing, discharge or decreased vision, and should be warned to immediately seek the help of an ophthalmologist if any of these symptoms develop in the operated eye. Endophthalmitis is more common if the bleb is thin and cystic or leaking.
- Accelerated progression of cataract is frequently seen after filtration surgery.

The Guidelines project was entirely supported by the European Glaucoma Society Foundation

Br J Ophthalmol: first published as 10.1136/bjophthalmol-2025-egsguidelines on 8 September 2025. Downloaded from http://bjo.bmj.com/ on September 29, 2025 by guest.
Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

II.3.14.2.1.2 Trabeculotomy and goniotomy

Trabeculotomy, alone or combined with trabeculectomy, is generally used for paediatric glaucoma and is less frequently used in adults. Trabeculotomy may be also performed ab-interno if the cornea is clear with the gonioscopy assisted transluminar trabeculotomy (GATT) technique. GATT is also feasible in selected cases of open-angle glaucoma. Goniotomy is another viable alternative for paediatric glaucoma if the cornea is clear. (see also II.2.1)

II.3.14.2.2 Non-penetrating glaucoma surgery (NPGS)

These techniques are deep sclerectomy, canaloplasty and viscocanalostomy. Deep sclerectomy leads to the creation of a filtering bleb and usually involves the use of antifibrotic agents. Canaloplasty and viscocanalostomy additionally dilate Schlemm's canal. These techniques were developed with the aim to lower IOP in OAG while exposing the patient to less severe postoperative complications, in particular hypotony. Long-term IOP lowering is less than with trabeculectomy. NPGS generally takes longer to master surgically than trabeculectomy.

Trabeculectomy versus non-penetrating glaucoma surgery

Factors in favour of trabeculectomy	Factors in favour of NPGS
– Lower long-term postoperative IOP – Fewer postoperative IOP-lowering IOP-lowering medications	– Fewer hypotony-related complications – Lower rate of cataract formation – Less intensive postoperative care (e.g. bleb management)

II.3.14.2.3 Long-tube glaucoma drainage devices (GDDs)

Long-tube glaucoma drainage devices (GDDs), also known as aqueous shunts or "tubes", have become increasingly common in the surgical management of glaucoma. These are mainly indicated for patients in whom trabeculectomy with antifibrotics is unlikely to be effective (see Ch II.3.14), or carries greater risk or has already failed. These drainage devices generally consist of a long synthetic tube connected to a synthetic plate. The tube enables aqueous humour to be drained to the plate wich is positioned retroequatorially, therefore far more posteriorly than by trabeculectomy. The implantation of any such device is often referred to as "tube surgery".
Different types of GDDs are commercially available and vary in terms of design and technical characteristics (e.g. Molteno©, Baerveldt©, Ahmed©, Paul Glaucoma Implant© etc). The published evidence does not support clear superiority of one device over any of the others. Also, there is no high-quality evidence to support the use of antifibrotic agents, such as mitomycin, with tube surgery.
GDDs can achieve long-term IOP control usually in combination with IOP-lowering drops.

The Guidelines project was entirely supported by the European Glaucoma Society Foundation

Br J Ophthalmol: first published as 10.1136/bjophthalmol-2025-egsguidelines on 8 September 2025. Downloaded from http://bjo.bmj.com/ on September 29, 2025 by guest.
Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

However, some patients will require further surgery to achieve target pressure. Diode laser or a second tube may need to be considered if the IOP remains uncontrolled.

Indications:
- Failed filtration surgery
- High risk of failure of filtration surgery
- Most forms of secondary glaucoma
- Refractory paediatric glaucoma, particularly when less invasive surgery has failed

Significant risks of GDDs:
- Vision threatening hypotony in the early postoperative period; non-valved tubes should be stented and/or ligated to reduce this risk
- Exposure of the implant and associated risk of endophthalmitis
- Long term corneal decompensation, particularly if the tube is close to the corneal endothelium

Trabeculectomy versus GDDs

Factors in favour of trabeculectomy	Factors in favour of long tube GDDs
– No implant/foreign body, no risk of tube exposure – Lower risk of corneal decompensation – More options for further glaucoma surgery	– High risk of filtration surgery failure – Less intensive postoperative care – Lower risk of postoperative wound leak

- Trabeculectomy with anti-fibrotic agents remains the most efficient surgical procedure to lower IOP long-term
- The use of anti-fibrotic agents, which is routinely part of bleb-forming glaucoma surgeries, is associated with a higher risk of hypotony and bleb related complications
- Long-tube drainage devices should be considered for patients in whom trabeculectomy with antifibrotics is unlikely to be effective or has already failed

II.3.14.2.4 Additional/alternative surgical techniques

Surgical procedures, entailing less tissue manipulation with the expectation of a better safety profile and quicker recovery as compared to conventional filtration surgery, have been developed.
Ab interno, non-bleb forming approaches can be defined as minimally invasive or micro- incisional glaucoma surgery or “MIGS”. MIGS tend to have a modest IOP-lowering effect but can reduce the burden of medication, although the latter is not in line with the traditional aim of glaucoma surgery. The target population is also largely different to that of conventional filtering surgery. MIGS could be suitable for patients with mild to

The Guidelines project was entirely supported by the European Glaucoma Society Foundation

Br J Ophthalmol: first published as 10.1136/bjophthalmol-2025-egsguidelines on 8 September 2025. Downloaded from http://bjo.bmj.com/ on September 29, 2025 by guest.
Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

moderate glaucoma or with OHT. All these procedures are most commonly combined with phacoemulsification. This has made it difficult to distinguish the IOP lowering effect of MIGS from that induced by phacoemulsification alone. The field of MIGS is also rapidly expanding and their role in clinical practice needs to be viewed in the context of emerging evidence, long-term effects on IOP and on visual field progression.

Ab interno and *ab externo* bleb-forming devices in the shape of miniaturized tubes without a plate are another relatively recent addition to the glaucoma surgical armamentarium. These techniques were originally developed as a complement to bleb-forming surgeries such as trabeculectomy. The devices are based on Pouiseille's law of fluidics and aim to provide a standardized method of aqueous outflow into the subconjunctival space, with potentially added IOP lowering when compared to MIGS. These devices are dependent on bleb formation and therefore, to be successful, need strategies to prevent bleb scarring such as intraoperative antimetabolite use and post-operative bleb management. They also have a higher risk of potential complications requiring specific expertise, such as hypotony and bleb failure. A complete description of this evolving field is not within the scope of this chapter. More details on surgical techniques, efficacy and complications of such procedures can be found in the "Guide on Surgical Innovation for Glaucoma" published by the EGS in 2023.

See *https://www.eugs.org/educational_materials/146*

Definition and classification of techniques:

Ab interno non-bleb-forming procedures which aim to increase trabecular or suprachoroidal outflow and are labelled as Minimally Invasive Glaucoma Surgery (MIGS). They are designed to enhance outflow with minimal disruption of the normal anatomy/physiology with a good safety profile, fast recovery time, reduced postoperative interventions and follow up visits. However, hypotensive efficacy is evidently lower than with bleb-forming surgeries and IOP will rarely remain below the mid-teens.

Relatively short, thin tube devices with no plate which rely on the formation of a bleb to lower the IOP are generally categorized as minimally invasive bleb surgery or MIBS. Bleb-forming techniques cannot be categorized as MIGS, as they are more invasive and comparatively carry more risks. As with any bleb-forming surgery, there is the inherent potential for severe complications. Accordingly, one may still consider these procedures as moderately invasive especially when risk assessment guides clinical decision-making. The aim of this subchapter is to provide a summary overview of such techniques and indications.

The Guidelines project was entirely supported by the European Glaucoma Society Foundation

Br J Ophthalmol: first published as 10.1136/bjophthalmol-2025-egsguidelines on 8 September 2025. Downloaded from http://bjo.bmj.com/ on September 29, 2025 by guest. Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

MIGS classification:
MIGS can be classified as in the following table:

Categories	Procedure/Devices
1. Trabecular procedures	
1.1 Trabecular implants/stenting	iStent™ (Glaukos Corporation, Laguna Hills, CA, USA), Hydrus™ (Alcon Laboratories Inc., Fort Worth, TX, USA)
1.2 Trabecular surgeries	
1.2.1 Trabecular viscodilation	ABIC (iTrack Advance™Nova Eye, Inc), OMNI™ (Sight Sciences, CA USA) Streamline™ (New World Medical, Inc; Rancho Cucamonga, CA, USA)
1.2.2 Trabecular disrupting surgeries	GATT OMNI™ (Sight Sciences, CA USA) Kahook Dual Blade™ (KDB, New World Medical, CA, USA) TrabEx™ (MicroSurgical Technology, Redmond, Washington, USA) Trabectome™ (Neomedix, Tustin, CA, USA)
1.2.3 Trabecular laser procedures	ELT™ (Bausch & Lomb, USA)
2. Suprachoroidal procedures	Miniject™ (iSTAR Medical SA, Wavre, Belgium)

Indications:
These techniques mainly aim to reduce the IOP and/or the medication burden in patients with early to moderate open angle glaucoma or OHT.
- They are mostly used in combination with phacoemulsification but some of them can also be used as stand-alone procedures.
- When making a treatment recommendation clinicians should consider the benefits of early MIGS surgery in the context of the patient characteristics (medical and nonmedical, lifestyle, expectations, etc.).

Contraindications:
- MIGS are not usually indicated for patients with advanced glaucoma, those needing lower target IOPs and those with angle closure.
- Trabecular MIGS should not be used in cases of elevated episcleral pressure, congenital anomalies of the angle/anterior chamber or neovascular glaucoma.

The Guidelines project was entirely supported by the European Glaucoma Society Foundation

Br J Ophthalmol: first published as 10.1136/bjophthalmol-2025-egsguidelines on 8 September 2025. Downloaded from http://bjo.bmj.com/ on September 29, 2025 by guest.
Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

II.3.14.2.4.1 Trabecular implants

In these procedures the outflow is increased by bypassing the trabecular meshwork, directing aqueous humour into the SC.
The iStent® (Glaukos Corporation, Laguna Hills, CA, USA) is currently made of non- ferromagnetic titanium with an 80 µm lumen diameter.
The Hydrus® microstent (Alcon Laboratories Inc., Fort Worth, TX, USA) is a crescent-shaped open structure with a curved design to match the curvature of the SC. It is made of nitinol, a nickel-titanium alloy, which bypasses the TM and scaffolds 3 clock hours of the SC.

II.3.14.2.4.2 Trabecular dilation

Ab-interno canaloplasty (ABIC) with a specialized microcatheter with an illuminated tip (iTrack™ Advance, Nova Eye, Inc). Involves 360° catheterization followed by pressurized viscodilation of Schlemm's canal (SC).

II.3.14.2.4.3 Trabecular disrupting surgeries

In these procedures the TM is cut or ripped exposing the SC to the aqueous humour flow.
The Kahook Dual Blade® (KDB, New World Medical, CA, USA) is a trabeculotomy procedure performed with a cutting, non-thermal instrument.
Gonioscopy-assisted transluminal trabeculotomy (GATT) is a modification of the 360° suture ab-externo trabeculotomy technique. GATT can also be performed using a Prolene suture introduced through a small TM incision.
The OMNI system (Sight Sciences, CA USA) allows for the combination of a dilating procedure with the additional possibility of performing a 180º-360º trabeculotomy.

II.3.14.2.4.4 Trabecular laser procedures

Excimer laser trabeculotomy (ELT; Bausch & Lomb, USA) aims to enhance the outflow facility by creating up to ten 210 micrometer holes through the anterior meshwork into the inner wall of Schlemm's canal. ELT is a non-thermal laser and collateral damage at the periphery of the ablation zone is reported to be limited.

II.3.14.2.4.5 Suprachoroidal devices

Suprachoroidal devices aim to create a controlled cyclodialysis cleft and improve uveoscleral outflow through a connection between the anterior chamber and the suprachoroidal space.
The MiniJect® (iSTAR Medical SA, Wavre, Belgium), is a small oblong implant
(length = 5.0 mm, width=1.1mm, thickness=0.6mm), made of silicone-based STAR® biomaterial.

The Guidelines project was entirely supported by the European Glaucoma Society Foundation

Br J Ophthalmol: first published as 10.1136/bjophthalmol-2025-egsguidelines on 8 September 2025. Downloaded from http://bjo.bmj.com/ on September 29, 2025 by guest.
Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

MIGS are not risk-free
Be aware of potential IOP spikes after MIGS and careful IOP monitoring after MIGS surgery is crucial
Careful patient selection and setting realistic expectations are essential

Keys for a successful MIGS Surgery:
Proficiency with intraoperative gonioscopy.
Adequate positioning of patient head and microscope.
The surgeon's posture needs to be adapted to these procedures. Being familiar with each device (inserters, probes, etc.).

II.3.14.2.5 Bleb-forming shunts/devices without a plate

This term applies to relatively short, thin tube devices with no plate which drain into the subconjunctival space and rely on the formation of a filtering bleb to achieve their effect (see Ch II3.14.2.4). This definition is made to distinguish them from, on one hand, 'traditional' longer tubes with plates (See Ch II.3.14.2.3) and on the other hand from trabecular bypass devices (See Ch II. 3.14.2.4). Bleb-forming shunts without a plate are also distinct from bleb-forming surgery which does not use a device. In theory therefore these devices could be an alternative to more traditional bleb-forming procedures such as trabeculectomy and deep sclerectomy. There is also an assumption that these shunts/devices without a plate have a lower risk of complications as they are considered less invasive, have standardized outflow based on Poiseuille's law and potentially have a more predictable post-operative IOP when compared to trabeculectomy.
Bleb-forming shunts/devices without a plate also tend to need less intensive post-operative follow-up which may also be beneficial for certain patient groups. They should be described to patients explaining that such surgery involves conjunctival and scleral incisions, postoperative bleb management and the same type of potential postoperative complications as traditional filtration surgery.
The currently available bleb-forming shunts/devices without a plate are the XEN-45 and XEN-63 (AbbVie Inc., Chicago, IL, USA) and the PreserFlo Microshunt (Santen, Osaka, Japan).

II.3.14.2.5.1 Xen™

The XEN 45 is a 45 µm lumen, 6 mm long hydrophilic stent made of porcine gelatine cross-linked with glutaraldehyde which is preloaded in a disposable injector with a 27-gauge, double-beveled needle. It was designed for ab interno implantation but an ab externo approach has also been described. The XEN 63, with a 63 µm lumen size, was introduced commercially in Canada and several European countries in 2022. The gelatin is designed to expand and become flexible when hydrated.

The Guidelines project was entirely supported by the European Glaucoma Society Foundation

Br J Ophthalmol: first published as 10.1136/bjophthalmol-2025-egsguidelines on 8 September 2025. Downloaded from http://bjo.bmj.com/ on September 29, 2025 by guest.
Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

II.3.14.2.5.2 Preserflo™

The PreserFlo MicroShunt is made of a flexible polymer (poly-styrene-block-isobutylene-block-styrene, or SIBS).
The total length of the PreserFlo MicroShunt is 8.5 mm with an outer diameter of 350 µm and an inner lumen size of 70 µm. The implantation is performed *ab externo*, enabling aqueous outflow from the anterior chamber under the conjunctiva and Tenon's capsule.

Indications:
- These techniques have the potential for greater IOP reduction when compared to MIGS and therefore can be considered in cases of more moderate and advanced glaucoma.
- The XEN45 and XEN63 are was designed for ab interno implantation with or without phacoemulsification surgery. It therefore could also be considered in patients with more advanced glaucoma who also need cataract surgery, particularly if the IOP is sub-optimal.

Contraindications:
- Relative contraindications as with other bleb forming procedures, including traditional ones such as trabeculectomy, include: thin, unhealthy conjunctiva, prior conjunctival surgery such as pars plana vitrectomy or failed bleb-forming surgery, high myopia, congenital glaucoma, secondary glaucomas.
- Further explanation and discussion on indications, contraindications, techniques, expert consensus and evidence can be found in the Guide on Surgical Innovation for Glaucoma. See https://www.eugs.org/educational_materials/146

When choosing the implant location, consider anatomical factors, development of scarring and side-effects of antimetabolite which could affect future surgeries.

Proper positioning of these devices in the anterior chamber is crucial to minimise the potential risk of endothelial cell loss.

The appropriate use of antimetabolites is key to the success of bleb-forming devices. Although higher doses of Mitomycin C result in better IOP-lowering outcomes, they need to be balanced with the potential risks associated with stronger antimetabolite use (e.g. bleb leaks or hypotony).

Consider temporary intraluminal stenting of a PreserFlo in patients where hypotony could be clinically more relevant, like in axial myopia.

The Guidelines project was entirely supported by the European Glaucoma Society Foundation

Br J Ophthalmol: first published as 10.1136/bjophthalmol-2025-egsguidelines on 8 September 2025. Downloaded from http://bjo.bmj.com/ on September 29, 2025 by guest. Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

Systematic reviews:
- King AJ, Shah A, Nikita E, et al. Subconjunctival draining minimally-invasive glaucoma devices for medically uncontrolled glaucoma. Cochrane Database Syst Rev. 2018;12(12):CD012742.
- Le JT, Bicket AK, Wang L, Li T. Ab interno trabecular bypass surgery with iStent for open angle glaucoma. Cochrane Database Syst Rev. 2019;3(3):CD012743.
- Otarola F, Virgili G, Shah A, Hu K, Bunce C, Gazzard G. Ab interno trabecular bypass surgery with Schlemm´s canal microstent (Hydrus) for open angle glaucoma. Cochrane Database of Systematic Reviews 2020; 3: CD012740.
- Gillmann K, Hornbeak DM. Rates of visual field change and functional progression in glaucoma following trabecular microbypass implantation of iStent technologies: a meta-analysis. BMJ Open Ophthalmol. 2024 Feb 15;9(1):e001575.

Further references:
- Abegao Pinto L, Sunaric Mégevand G, Stalmans I, Azuara-Blanco A, Bron A, Garcia Feijoo J, Garway Heath T, Grehn F, King A, Kirwan J, McNaught A, Mercieca K, Oddone F, Saldanha I, Spaeth G, Topouzis F, Enrico Traverso C, Tuulonen A; EGS Surgery Taskforce. European Glaucoma Society A guide on surgical innovation for glaucoma. Br J Ophthalmol. 2023 Dec 21;107(Suppl 1):1-114

II.3.14.3 Methods of preventing filtering bleb scarring

II.3.14.3.1 Antifibrotic agents

Wound healing is one of the main determinants of long-term IOP control after filtering surgery. Risk factors for conjunctival scarring include young age, African-descent, inflammatory eye disease, long-term multiple medical therapy, aphakia, complicated cataract surgery, recent intraocular surgery (<3 months), previous conjunctival incisional surgery, previous failed glaucoma filtration surgery, neovascular glaucoma.
Antifibrotics such as 5-fluorouracil (5-FU) and mitomycin-C (MMC) are routinely used in patients undergoing glaucoma filtration surgery in order to reduce postoperative conjunctival scarring and improve drainage.
Although 5-FU and MMC are not officially approved for ocular surgery, their off-label use in filtration surgery has become standard clinical practice and there is ample evidence supporting their efficacy in improving the IOP lowering effect of filtration surgery.
There is some low-quality evidence that MMC may be more effective in achieving long- term lower intraocular pressure and in reducing corneal injury after trabeculectomy compared to 5-FU. There is no high-quality evidence to support the use of antifibrotic agents in tube shunt surgery.

Systematic reviews:
- Wormald R, Wilkins MR, Bunce C. Post-operative 5-Fluorouracil for glaucoma surgery. Cochrane Database Syst Rev. 2001;(3):CD001132.doi: 10.1002/14651858.CD001132. Update in: Cochrane Database Syst Rev. 2014 Feb 19;(2):CD001132. doi: 10.1002/14651858.CD001132.pub2. PMID: 11686977.

The Guidelines project was entirely supported by the European Glaucoma Society Foundation

Br J Ophthalmol: first published as 10.1136/bjophthalmol-2025-egsguidelines on 8 September 2025. Downloaded from http://bjo.bmj.com/ on September 29, 2025 by guest.
Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

- Cabourne E, Clarke JCK, Schlottmann PG, Evans JR. Mitomycin C versus 5-Fluorouracil for wound healing in glaucoma surgery. Cochrane Database of Systematic Reviews 2015, Issue 11. Art. No.: CD006259. DOI: 10.1002/14651858.CD006259.pub2
- Foo VHX, Htoon HM, Welsbie DS, Perera SA. Aqueous shunts with mitomycin C versus aqueous shunts alone for glaucoma. Cochrane Database Syst Rev. 2019 Apr 19;4(4):CD011875. doi: 10.1002/14651858.CD011875.pub2. PMID: 30999387; PMCID: PMC6472957.
- Cui S, Zhang J, Zhang S, Li J, Li Q. Effect of mitomycin C and 5-fluorouracil on wound healing in patients undergoing glaucoma surgery: A meta-analysis. Int Wound J. 2024 Mar;21(3):e14500. doi: 10.1111/iwj.14500. Epub 2023 Nov 21. PMID: 37990074; PMCID: PMC10898392.
- Figueiredo R, Barbosa-Breda J. The efficacy of adjunctive mitomycin C and/or anti-VEGF agents on glaucoma tube shunt drainage device surgeries: a systematic review. Graefes Arch Clin Exp Ophthalmol. 2024 Oct;262(10):3273-3286. doi: 10.1007/s00417-02406476-z. Epub 2024 Apr 24. PMID: 38656422; PMCID: PMC11458658.

II.3.14.3.1.1 General precautions for the use of antifibrotics

The use of antifibrotics is potentially hazardous and requires careful surgical technique to prevent complications as well as precautions and specific procedures for preparation and disposal. Early and late excessive filtration and hypotony or a focally thin bleb that is associated with a higher risk of infection, are more common with antifibrotics. The application of antifibrotic on a larger treatment area and the use of a fornix-based conjunctival flap may minimise the occurrence of thin cystic blebs. It is important to assess each individual case for risk factors, and/or the need of low target IOP and choose the substance, concentration, method of administration, volume and duration of exposure used. The use of antifibrotics will enhance the unfavourable effect of any imprecision occurring during surgery.

Strategies to increase control of flow should be considered, such as smaller sclerostomies, larger and/or thicker scleral flaps, tighter suturing of the scleral flap, focal pressure and releasable or adjustable sutures.

A large surface area of cytotoxic treatment together with large scleral flaps and accurately sutured fornix-based conjunctival flaps appear to lead to a more diffuse, posteriorly extended non-cystic blebs giving a considerable reduction in bleb-related complications such as blebitis and endophthalmitis.

Antimetabolites should not enter the eye. Contact with the cut edge of conjunctival flaps should be avoided.

The Guidelines project was entirely supported by the European Glaucoma Society Foundation

Br J Ophthalmol: first published as 10.1136/bjophthalmol-2025-egsguidelines on 8 September 2025. Downloaded from http://bjo.bmj.com/ on September 29, 2025 by guest. Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

5-Fluorouracil (5-FU):

Intraoperative use

- Concentration: 25 or 50 mg/ml undiluted solution. Administration on a filter paper or sponge or by subconjunctival injection
- Time of exposure: usually 5 minutes. Rinse after exposure with at least 20 ml of balanced salt solution

Postoperative use

- Concentration: 0.1 ml injection of 50 mg/ml undiluted solution
- Administration: subconjunctival injection adjacent to but not into bleb (pH 9), with a small caliber needle (e.g. 30 G needle on insulin syringe). Reflux from the injection site over the ocular surface should be prevented by pressing with a dry sponge or Q-tip
- A very small amount of 5 FU entering the eye will irreversibly damage the endothelium
- Relative contraindication: corneal epithelium compromise
- Repeated injections are often necessary

Mitomycin C (MMC):

Intraoperative use

- Concentration: 0.1-0.5 mg/ml
- Administration: intraoperatively on a filter paper or a sponge or by subconjunctival injection. Both methods of MMC application during trabeculectomy are equally effective for IOP reduction, but they may differ in their impact on bleb morphology and postoperative medication requirement
- Time of exposure: 1-5 minutes if on a filter paper or sponge
- Injection: 0.1 ml injection of 0.1-0.5 mg/ml solution
- Rinse after exposure with at least 10-20 ml of balanced salt solution

Postoperative use

- Concentration: 0.1 ml injection of 0.1-0.5 mg/ml solution
- Administration: adjacent to but not into the filtration bleb, with a 30 G needle. Reflux from the injection site over the ocular surface should be prevented by pressing with a dry sponge or Q-tip applicator
- A very small amount of MMC entering the eye will irreversibly damage the endothelium
- Repeated injections are often necessary

Systematic reviews:

- Zheng J, Zhang A. Efficacy and safety of intraoperative injection of mitomycin C during trabeculectomy: a systematic review and meta-analysis. Int Ophthalmol. 2024 Sep 6;44(1):372. doi: 10.1007/s10792-024-03291-7. PMID: 39240391.

The Guidelines project was entirely supported by the European Glaucoma Society Foundation

Br J Ophthalmol: first published as 10.1136/bjophthalmol-2025-egsguidelines on 8 September 2025. Downloaded from http://bjo.bmj.com/ on September 29, 2025 by guest.
Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

II.3.14.4 Alternative methods of preventing filtering bleb scarring

Beta radiation was shown to be efffective in clinical trials.
The effect on IOP control of anti-VEGF agents in glaucoma patients undergoing trabeculectomy is still uncertain, compared to MMC.
Anti-VEGFs as an adjunct to conventional treatment could help reduce IOP in neovascular glaucoma in the short term and reduce intraoperative bleeding.

Systematic reviews:

- Kirwan J F, Rennie C, Evans J R. Beta radiation for glaucoma surgery. Cochrane Database of Systematic Reviews 2012, Issue 6. Art. No.: CD003433. DOI: 10.1002/14651858.CD003433.pub3
- Cheng J, Cheng S, Wei R, Lu G. Anti-vascular endothelial growth factor for control of wound healing in glaucoma surgery. Cochrane Database of Systematic Reviews 2016, Issue 1. Art. No.: CD009782. DOI: 10.1002/14651858.CD009782.pub2
- Rittiphairoj T, Roberti G, Michelessi M. Anti-vascular endothelial growth factor for neovascular glaucoma. Cochrane Database of Systematic Reviews 2023, Issue 4. Art. No.: CD007920. DOI: 10.1002/14651858.CD007920.pub4.

The Guidelines project was entirely supported by the European Glaucoma Society Foundation

Br J Ophthalmol: first published as 10.1136/bjophthalmol-2025-egsguidelines on 8 September 2025. Downloaded from http://bjo.bmj.com/ on September 29, 2025 by guest.
Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

II.3.15 Cataract and glaucoma surgery

When the patient has coexistent glaucoma and cataract, a personalised approach should be taken. Uncomplicated phacoemulsification with clear cornea inicisons may affect subsequent glaucoma surgical procedures only if done soon after cataract surgery. The development or worsening of a visually significant cataract is common after glaucoma surgery. Cataract surgery performed after trabeculectomy can affect the IOP control. The role of adjuvant wound modulating therapy at the time of cataract surgery to promote survival of a previously functioning trabeculectomy is unclear.

Cataract surgery alone can modestly but consistently reduce IOP and medications in POAG, with a more pronounced effect in eyes with PXG and higher preoperative IOP values. However, the exact magnitude and duration of this IOP lowering is not completely understood due to an array of confounding factors, including topical IOP- lowering medications. Additionally, a minority of these patients can experience a large postoperative IOP spike which can potentially worsen their pre-existing neuropathy. In general, cataract surgery alone is not recommended as a procedure to control IOP in open-angle glaucoma. With appropriate techniques, phacoemulsification is safely applicable in cases with small pupil, shallow AC or pre-existing filtering blebs.

Combining glaucoma procedures with phacoemulsification allows for greater IOP reduction than phacoemulsification alone. The success rate of combined phacoemulsification and bleb-forming surgery is less than stand-alone bleb-forming procedures. There is insufficient evidence comparing outcomes of sequential versus combined cataract and glaucoma surgery to inform our choice, and limited consensus on a generalised approach does not allow strong recommendations. For these reasons, an individualised approach is recommended. Whenever the clinical condition allows, sequential surgery with phacoemulsification performed initially should be considered. The main criteria to consider when evaluating whether to perform combined or staged procedures and with which type of glaucoma surgery should include the severity of the disease (mild, moderate, or advanced) and the preoperative IOP. See Ch II.3.14. MIGS can be expected to lower IOP only moderately and reduce the need for medications in cases with mild disease. For more severe disease or cases where preoperative IOP is high, a bleb-forming technique is likely to result in lower IOP and is therefore preferred. In angle closure disease, if there is symptomatic cataract prompt cataract surgery is recommended. If there is PACG and no symptomatic cataract, clear lens extraction should be considered, particularly for patients ≥50 years of age. See Ch II. 2.4.

Systematic reviews:

- Ng WS, Jayaram H.Adjunctive modulation of wound healing during cataract surgery to promote survival of a previous trabeculectomy.Cochrane Database of Systematic Reviews 2021, Issue 8. Art. No.: CD013664. DOI: 10.1002/14651858.CD013664.pub2.
- Chen PP, Lin SC, Junk AK, Radhakrishnan S, Singh K, Chen TC. The Effect of Phacoemulsification on Intraocular Pressure in Glaucoma Patients: A Report by the American Academy of Ophthalmology. Ophthalmology. 2015 Jul;122(7):1294-307. doi: 10.1016/j.ophtha.2015.03.021. Epub 2015 May 2. PMID: 25943711.
- Brízido M, Rodrigues PF, Almeida AC, Abegão Pinto L. Cataract surgery and IOP: a systematic review of randomised controlled trials. Graefe's Archive for Clinical and Experimental Ophthalmology = Albrecht von Graefes Archiv fur Klinische und

The Guidelines project was entirely supported by the European Glaucoma Society Foundation

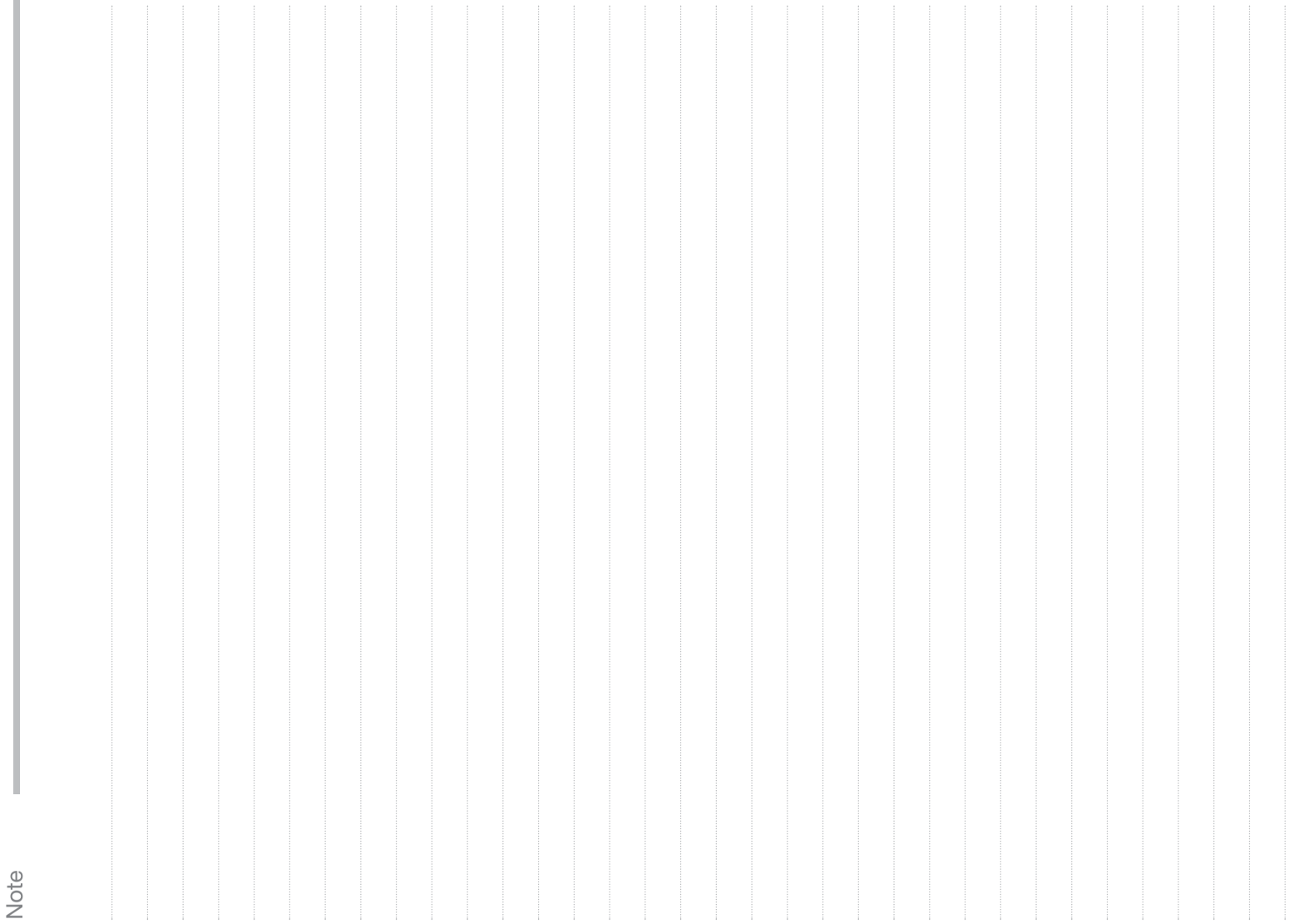
Br J Ophthalmol: first published as 10.1136/bjophthalmol-2025-egsguidelines on 8 September 2025. Downloaded from http://bjo.bmj.com/ on September 29, 2025 by guest.
Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

Experimentelle Ophthalmologie. 2023 May;261(5):1257-1266. DOI: 10.1007/s00417-022- 05911-3. PMID: 36441227.
- Benekos K, Katsanos A, Haidich AB, Dastiridou A, Nikolaidou A, Konstas AG. The Effect of Phacoemulsification on the Intraocular Pressure of Patients With Open Angle Glaucoma: A Systematic Review and Meta-Analysis. J Glaucoma. 2024 Aug 1;33(8):576-586. doi: 10.1097/IJG.0000000000002386. Epub 2024 Apr 5. PMID: 38573897.
- Yuan PHS, Dorling M, Shah M, Panarelli JF, Durr GM. Combined Microinvasive Glaucoma Surgery With Phacoemulsification in Open-Angle Glaucoma: A Systematic Review and Meta-analysis. Am J Ophthalmol. 2025 Feb;270:154-163. doi: 10.1016/j.ajo.2024.07.034. Epub 2024 Jul 31. PMID: 39089358.
- Xie J, Li W, Han B. The Treatment of Primary Angle-Closure Glaucoma with Cataract: A Systematic Review and Meta-Analysis of Randomised Controlled Trails. Ophthalmol Ther. 2023 Apr;12(2):675-689. doi: 10.1007/s40123-022-00639-z. Epub 2022 Dec 29. PMID: 36580218; PMCID: PMC10011357.

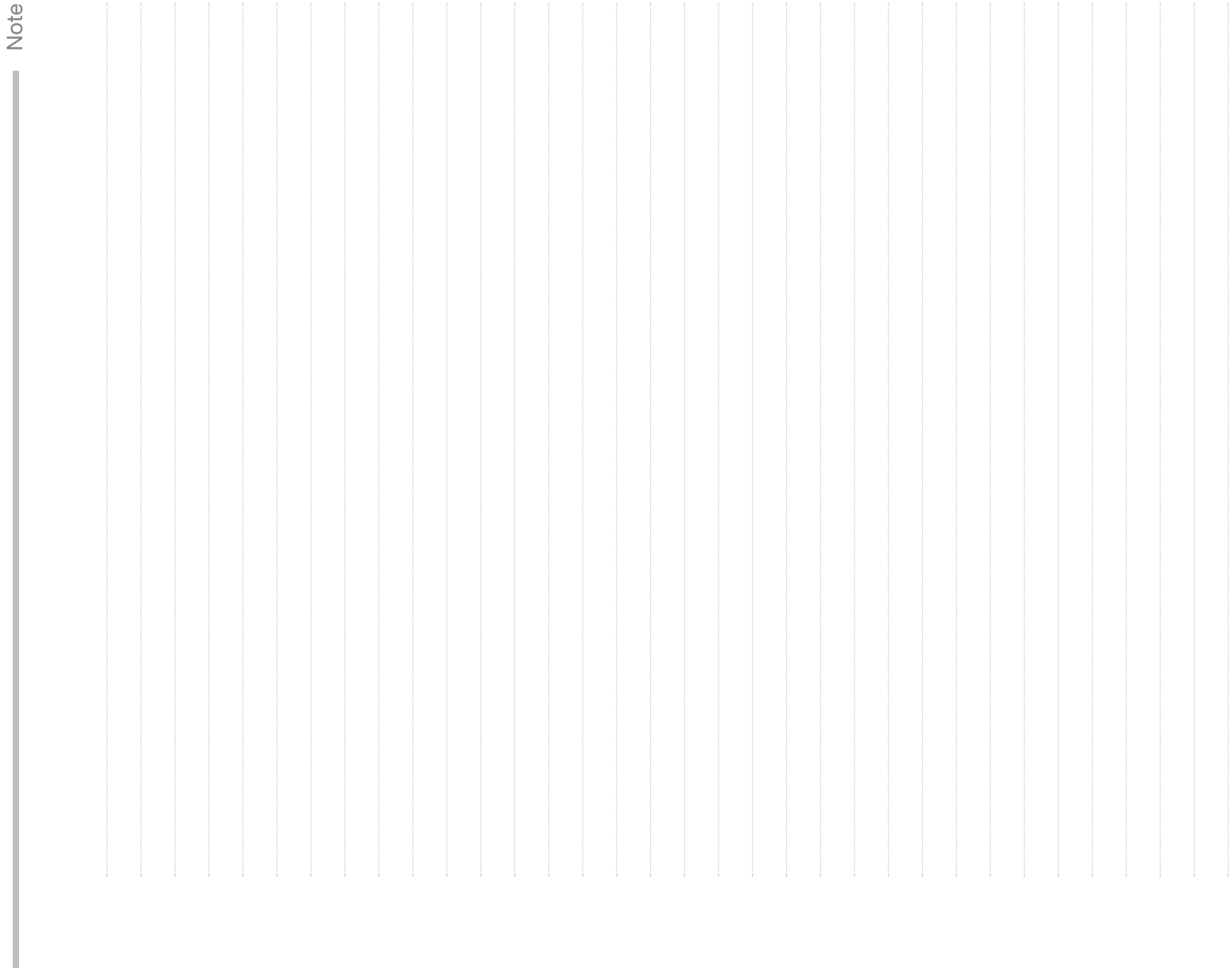
The Guidelines project was entirely supported by the European Glaucoma Society Foundation

Br J Ophthalmol: first published as 10.1136/bjophthalmol-2025-egsguidelines on 8 September 2025. Downloaded from http://bjo.bmj.com/ on September 29, 2025 by guest.
Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

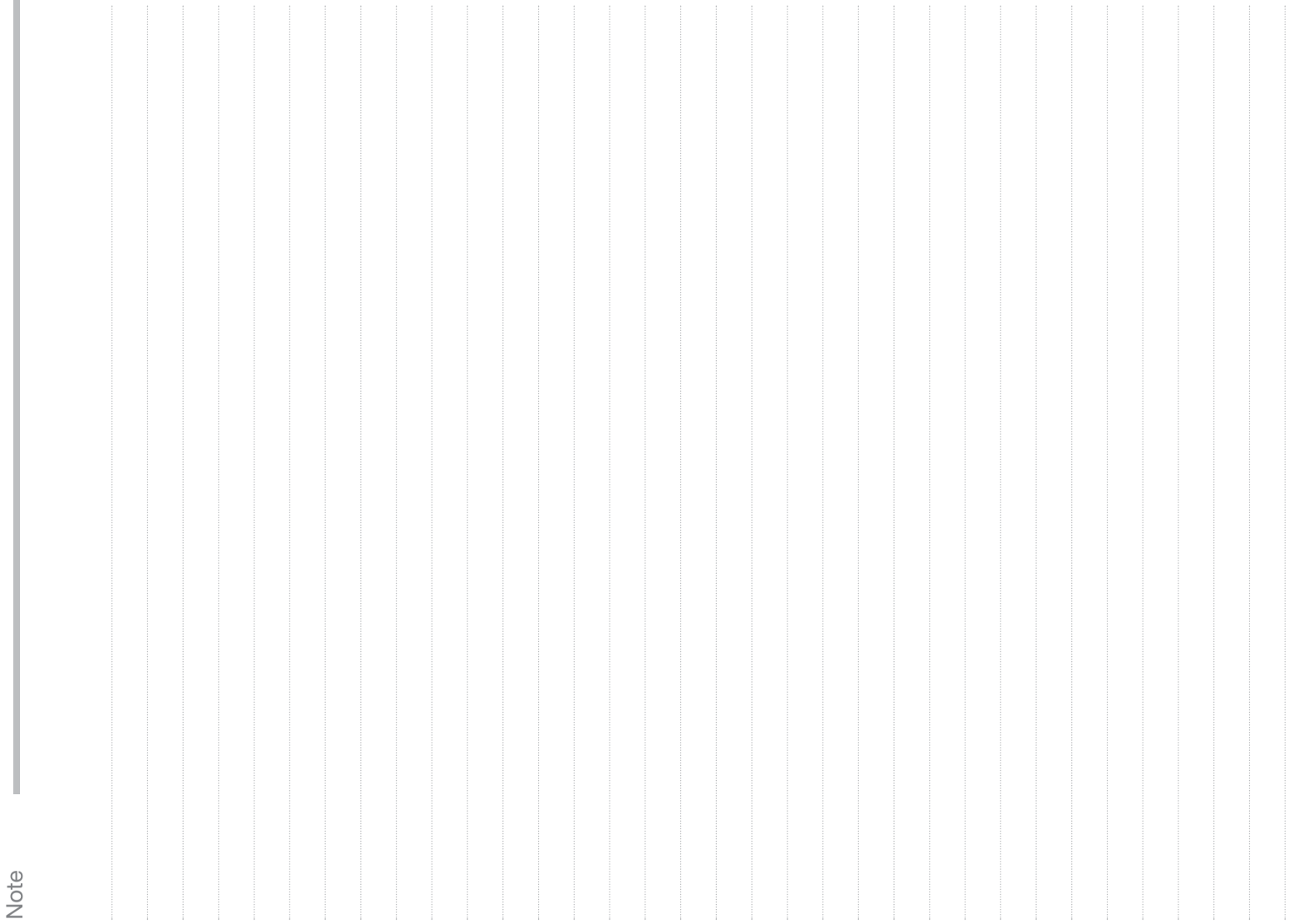
Br J Ophthalmol: first published as 10.1136/bjophthalmol-2025-egsguidelines on 8 September 2025. Downloaded from http://bjo.bmj.com/ on September 29, 2025 by guest.
Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.



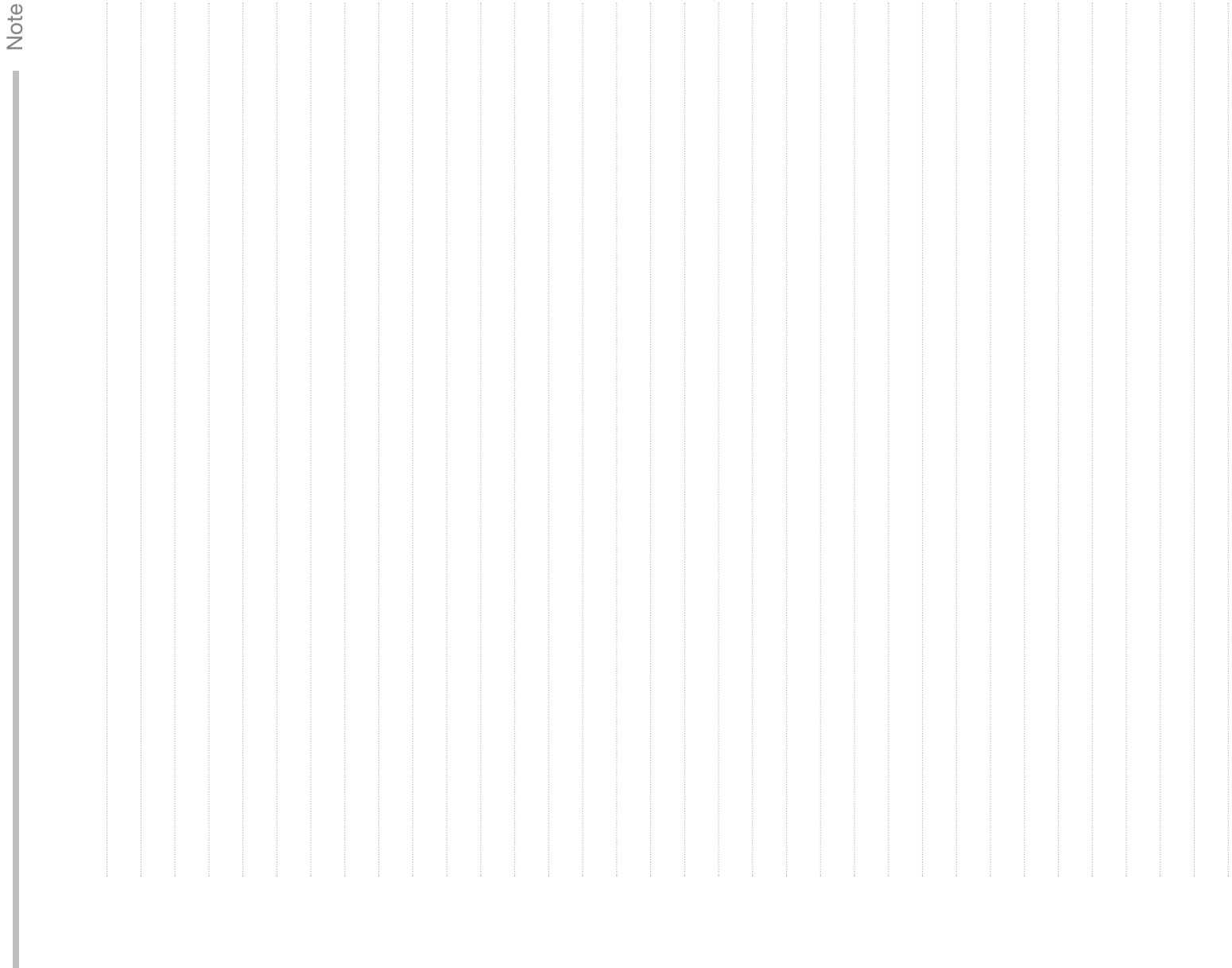
Br J Ophthalmol: first published as 10.1136/bjophthalmol-2025-egsguidelines on 8 September 2025. Downloaded from http://bjo.bmj.com/ on September 29, 2025 by guest.
Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.



Br J Ophthalmol: first published as 10.1136/bjophthalmol-2025-egsguidelines on 8 September 2025. Downloaded from http://bjo.bmj.com/ on September 29, 2025 by guest.
Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.



Br J Ophthalmol: first published as 10.1136/bjophthalmol-2025-egsguidelines on 8 September 2025. Downloaded from http://bjo.bmj.com/ on September 29, 2025 by guest.
Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.



Br J Ophthalmol: first published as 10.1136/bjophthalmol-2025-egsguidelines on 8 September 2025. Downloaded from http://bjo.bmj.com/ on September 29, 2025 by guest.
Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

ISBN 979-12-80718-29-7